3483

The Journal

OF THE

BOARD OF AGRICULTURE

VOL. XXII.

(April, 1915, to March, 1916.)

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
BY JAS. TRUSCOTT & SON, LTD., SUFFOLK LANE, CANNON STREET, E.C.,
AND PUBLISHED BY THE BOARD OF AGRICULTURE AND FISHERIES.

SUPPLEMENTS TO THE JOURNAL OF THE BOARD OF AGRICULTURE.

No. 1.—Report on Agricultural Education in the United States	Jan., 1908
No. 2.—The Food of Some British Birds ..	Dec., 1908
No. 3.—Reports on the Work of the International Agricultural Institute	April, 1910
No. 4.—Wheat: Papers Read at a Meeting of the British Association at Winnipeg, 1909	June, 1910
No. 5.—Influence on the Production of Mutton of Manures Applied to Pasture	Jan., 1911
No. 6.—Report on the Work of the International Agricultural Institute	July, 1911
No. 7.—The Interpretation of the Results of Agricultural Experiments ..	Nov., 1911
No. 8.—Report on the Isle of Wight Bee Disease	May, 1912
No. 9.—Notes on Kerry Woods, illustrating Methods of Collecting and Utilising Information for a Forest Survey	Aug., 1912
No. 10.—Further Report on the Isle of Wight Bee Disease	July, 1913
No. 11.—The Correlation between the Percentage of Milk Fat and the Quantity of Milk Produced by Ayrshire Cows	Aug., 1913
No. 12.—Report on the Possibility of Reviving the Flax Industry in Great Britain	Jan., 1914
No. 13.—Seed Control Stations on the Continent	Aug., 1914
No. 14.—Report on the Poultry Industry in Wales	Oct., 1915

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 1.

APRIL, 1915.

DRIED YEAST AS FOOD FOR FARM STOCK.

CHARLES CROWTHER, M.A., PH.D.

Department of Agriculture, University of Leeds.

THE brewing of beer from malt and hops gives rise to three by-products which are of interest to the farmer in making up rations for his stock, viz., *grains* (wet or dried), *spent hops* and *yeast* (wet, compressed or dried).

In this country the feeding of brewers' grains, especially to cows in milk, is a widespread and long-established practice, whilst in recent years the use of spent hops in the guise of various proprietary compound foods has been considerably extended. So far as the writer is aware, however, little or no outlet has been found on the farm for the surplus yeast of the brewery, except possibly in the immediate neighbourhood of the larger centres of the brewing industry.

This surplus is very considerable, and the disposal of it to advantage has for many years occupied the attention of the brewer. At one time the surplus yeast of the brewery was largely utilised in the baking of bread, but in the last few decades, with the rise of the compressed yeast industry supplying a superior product for baking purposes, and with changes in brewing leading in many cases to the production of yeast of inferior value for baking purposes, this outlet for the brewers' surplus yeast has steadily diminished. No data are available for the output of British breweries, but for

B

Germany it was estimated for the year 1912 that of the total output of roughly 69,000 tons of brewers' yeast not more than 9,800 tons would be used by bakers.

Various attempts have been made to turn out from the brewery a yeast equal for baking purposes to compressed yeast, but without appreciable success.

More success has attended the efforts to prepare extracts of yeast suitable for human consumption as a substitute for meat extracts, but only a comparatively small proportion of the available yeast can as yet be disposed of in this way. Meanwhile much attention is being given to the possibilities of yeast as a food for farm stock.

The outstanding feature of yeast regarded as food is its high content of albuminoids, these commonly forming about 55 per cent. of the dry matter. Fresh yeast and pressed yeast have been used to some extent in feeding cattle and pigs, with apparently quite satisfactory results. In these forms, however, yeast is easily spoilt, and must be fed without much delay, especially in summer, so that it is only practicable to use it in the near neighbourhood of the brewery, and even there it must be procured in relatively small quantities at a time. Furthermore, owing to the fact that the yeast retains its vitality, scrupulous care is necessary to avoid contamination of other foodstuffs stored on the farm.

With the construction of more efficient drying apparatus it has now become possible to put on the market a dried yeast which is free from the foregoing objections, whilst retaining the nutrient matters of the yeast in highly digestible form. The output is as yet not very great, but that the industry is a rapidly growing one is indicated by the fact that, according to a summary recently published,* the number of yeast-drying works rose between 1910 and 1913 from 5 to 26. So far as the writer knows there are at present perhaps four or five yeast-drying plants at work in this country, with an annual output of some 2,000 to 3,000 tons. The product has so far been mainly exported to Germany, where dried yeast has grown in favour so rapidly that the demand is said to have exceeded the supply.

It is thus obvious that the practical experience of the German farmer with the food has been very favourable, and

* Hayduck: International Institute, Monthly Bulletin of Agricultural Intelligence, IV., 692 (May, 1913).

this is substantiated by the scientific and practical investigations carried out by Völtz and his colleagues in connection with the Institute of Fermentation Industries in Berlin.

It seems desirable, therefore, that, apart from the exceptional circumstances of the moment, the attention of the British farmer should be directed to this new feeding material, and especially that, if the claims as to its merits can be substantiated, every effort should be made to develop the home demand to such an extent as to render exportation in the future as unnecessary as it is undesirable.

With the object of gaining direct experience of the qualities of dried yeast as a foodstuff, observation and experimental tests have been made at the Manor Farm, Garforth (Experimental Farm of the University of Leeds and the Yorkshire Council for Agricultural Education) throughout the past winter.

Composition of Dried Yeast.—Before proceeding to deal with these experiments a brief exposition of the composition of dried yeast, and of the claims made for it, mainly on the basis of German experience and experiments, may first be given.

The material is of powdery to flaky consistency, varying in colour from light to medium brown. It has an agreeable smell, and its taste would not be amiss but for a bitterness, which is extremely pronounced in some samples, and which, according to experience at Garforth, is disliked by cows, but is not objected to by pigs and calves. This bitter taste arises presumably from the presence of hop residues with which the yeast is contaminated.

The composition of different samples is as follows :—

—	(1)	(2)	(3)	(4)	
	Average Per cent.	Per cent.	Per cent.	Per cent. *a*	*b*
Moisture	4·3	10·40	5·73	10·9	—
*Crude Albuminoids	48·5	49·63	45·56	48·3	44·3
Oil	0·5	1·45	1·40	0·5	—
Crude Fibre	0·5	3·60	4·17	1·6	—
Ash	10·7	9·30	4·20	8·1	—
Soluble Carbohydrates, &c.	35·5	25·62	38·94	30·6	—
	100·0	100·00	100·00	100·0	—
*Containing Nitrogen	7·76	7·94	7·29	7·73	7·09

The figures under (1) have been put forward as a representative average for dried yeast, those under (2) and (3) are given in the advertisements of two different makes of dried yeast, whilst under (4) is given the composition of the material used at Garforth.

The outstanding feature of the composition is the high percentage of albuminoids. Amongst commonly-used farm foods yeast is in this respect only equalled or closely approached by decorticated cotton seed meal or cake and soy bean meal or cake.

Digestibility.—Digestion trials in Germany with sheep have shown that fully 90 per cent. of the total organic matter, including practically the same proportion of the total albuminoids, is digestible.

Manurial Value.—In addition to the $7\frac{3}{4}$ per cent. of nitrogen, dried yeast contains phosphates equivalent to about $5\frac{1}{2}$ per cent. of phosphoric acid, and also about 2 per cent. of potash. Its manurial value, if assessed on the lines recently laid down by Hall and Voelcker, would thus amount to

Nitrogen. Phosphoric Acid. Potash.

$$(\tfrac{1}{2} \times 7\tfrac{3}{4} \times 15s.) + (\tfrac{3}{4} \times 5\tfrac{1}{2} \times 3s.) + (\tfrac{3}{4} \times 2 \times 4s.),$$

or £3 16*s.* 6*d.* per ton—an extraordinarily high figure. The gross cost of the yeast used at Garforth amounted to £9 5*s.* per ton.

Use in Germany.—German experience with dried yeast up to the present seems to have been uniformly favourable with practically all classes of stock, including poultry and geese, and especially with pigs. Occasional reference is made to difficulties with cows on account of the bitter flavour of the yeast.

Dietetic Properties.—In some quarters claims are made that the dried yeast has special dietetic properties which warrant a price considerably higher than that which would be deduced as reasonable from its composition, but until they have been substantiated by crucial experimental investigation the validity of such claims must be regarded as at least doubtful.

Tests with Dried Yeast at Garforth.—Feeding experiments with dried yeast have been carried out at Garforth with cows and pigs.*

* The writer is greatly indebted to Mr. H. J. Hargraves, N.D.A., for the care and success with which the practical work of the tests has been carried out.

The dried yeast used was a brown flaky material, with a pleasant aroma, but having a very bitter taste. The composition and cost have already been indicated.

Test with Cows.—Only eight cows giving sufficient milk for the purposes of the test were available, and these were divided into two lots of four each, regard being paid more especially to the stage of lactation of each individual in making the allotment. The test commenced on September 21st. 1914, and covered a period of 15 weeks, concluding on January 3rd, 1915. This period comprised four main experimental periods of three weeks each, during which the cows were fed as shown below—the allowance (per cow per day) of concentrated food only being shown, since the two groups were fed alike throughout the experiment so far as roots, hay, etc., were concerned.

—	Average per Cow per Day.	
	Group A.	Group B.
1st Experimental Period (Sept. 21–Oct. 11) ..	7 lb. Cake.	7 lb. Cake.
2nd ,, ,, (Oct. 26–Nov. 15) ..	7 lb. Cake.	4 lb. Cake, 3 lb. Yeast.
3rd ,, ,, (Nov. 23–Dec. 13) ..	4 lb. Cake, 3 lb. Yeast.	7 lb. Cake.
4th ,, ,, (Dec. 14–Jan. 3) ..	7 lb. Cake.	4 lb. Cake, 3 lb. Yeast.

The three weeks not included in the periods tabulated represent the time taken up in gradually effecting the changes of feeding indicated.

The cake used was a mixture, in equal parts, of linseed cake and undecorticated cotton cake (Egyptian), costing £7 8*s*. 6*d*. per ton (linseed, £9 3*s*. 6*d*.; cotton, £5 13*s*. 6*d*.).

The test was thus a comparison of the relative merits of 3 lb. of the cake mixture, and 3 lb. of dried yeast, the introduction of the latter in place of the cake increasing the cost of the ration by 0·6*d*. per cow per day.

At first the cows showed a violent dislike for the yeast, even when its smell and taste were masked by the addition of a little treacle. With one or two individuals the difficulty experienced in securing complete consumption of the yeast

was indeed very great,* but eventually all were induced to consume it without apparent dislike, though never greedily.

The cows were milked twice daily, and the yields of milk recorded. The average daily yields for each group in each period were as follows :—

Period.	Average Daily Yield of 4 Cows. Group A.	Group B.	For every 100 lb. milk given by Group A. Group B gave	Nature of Feeding.
1	2	3	4	5
	lb.	lb.	lb.	
1 ..	100·4	88·6	88·2	Both groups alike.
2 ..	96·0	91·2	95·0	Group B, yeast.
3 ..	88·2	81·7	92·6	Group A, yeast.
4 ..	78·3	74·2	94·8	Group B, yeast.

The comparison of the yields is most simply made by means of the data in the fourth column of the table. A small difference in favour of the yeast is indicated in periods 2 and 4.

Bearing in mind the small number of animals in each group, too much importance must not be attached to the actual numerical differences indicated. The only safe conclusion to draw is that, although there was an indication that the yeast was to some extent superior to the cake, the difference was too small to be measured reliably in a test with groups of 4 cows each.

No attempt was made to determine whether the yeast had any effect upon the percentage of fat in the milk, but the fortnightly tests to which all the cows of the Garforth herd are subjected gave no indication of marked differences between the "yeast" and "no yeast" periods.

The cows were weighed at fortnightly intervals throughout the experiment, and showed a steady gain of weight throughout, with a slightly increased rate during the "yeast" periods.

To sum up, it would appear that dried yeast is a food for cows if they can be induced to eat it, but the results obtained at Garforth do not warrant any extravagant claims as to its merits for this purpose. It is to be feared, however, that until some means of depriving it of its bitter taste has been devised, dried yeast will never come into general use as food for cows.

* Honcamp (*Mitt. der Deut. Landw. Gesell.*, Bd. 46, p. 635) reports that in his tests cows [illegible] food containing even small quantities of dried yeast.

Test with Pigs.—For the purpose of testing the merits of dried yeast in the feeding of pigs, two lots of 10 pigs each were selected. The pigs were all about 12 weeks old, and each lot was composed initially of 5 females and 5 castrated males, but deaths and the elimination of unsatisfactory animals eventually reduced one lot (Lot A) to 3 males and 3 females.

The general plan of the test was similar to that followed in the case of the cows, the yeast being introdnced into the ration of each lot alternately in successive 3-weekly periods.

The test commenced on 5th November, 1914, and continued for 15 weeks, being completed on 18th February, 1915.

The foodstuffs used, other than yeast, were wheat "sharps," bran, barley meal, maize meal, and a little treacle, whilst, in addition, a little ground chalk was given. In every case where yeast was used it replaced an equal weight of "sharps," the rations in all other respects being always alike for the two lots. The comparison made was thus a contrast of the feeding values of equal weights of dried yeast and "sharps." There is a very great difference between the albuminoid contents of these two foods, the "sharps" used containing only 14·7 per cent., but it was thought that the results would be more immediately useful in practice if the dried yeast were compared with a foodstuff that is widely used in pig-feeding, than if some material comparable in albuminoid content with dried yeast, but little used in pig-feeding, were selected for the comparison. No milk or dairy waste was used.

The pigs were weighed as lots weekly, whilst for the greater part of the period the weight of each individual was ascertained roughly at each weighing. It will be seen from the data given later that at some stages of the experiment the rate of growth of the pigs was not very satisfactory. The reasons for this were not very clear, but could not be associated with the yeast-feeding, since trouble was experienced in both "yeast" and "no-yeast" periods. Practical opinion suggested over-feeding in the earlier stages as the primary cause of trouble, but there was little evidence of this beyond the presence of undigested food in the stomachs of the animals that died, and the writer inclines rather to the opinion that the trouble was due partly to constitutional defects in certain of the animals and partly to the rather cramped accommodation furnished by the pens utilised during the first half of the experiment. This is suggested by the facts that the trouble was much

greater with Lot A than with Lot B, that two of the three pigs that died were of the same litter, and that after removal to more commodious quarters, where the pigs had ample freedom for exercise, little or no further difficulty was experienced.

The average weekly gains in live weight per pig for each successive 3-weekly period are set out below :—

Period.	Lot A. Weekly Ration per Pig.	Lot A. Weekly Gain per Pig.	Lot B. Weekly Gain per Pig.	Lot B. Weekly Ration per Pig.
1	15·2 lb. Sharps. 3·8 lb. Bran. 3·4 oz. Chalk.	3·37	*6·07*	11·7 lb. Sharps. 3·8 lb. Bran. 3·5 lb. Yeast. 3·4 oz. Chalk.
2	10·9 lb. Sharps. 3·6 lb. Bran. 3·4 lb. Yeast. 5·6 oz. Chalk.	*4·54*	2·86	14·3 lb. Sharps. 3·6 lb. Bran. 5·6 oz. Chalk.
3	12·6 lb. Sharps. 3·4 lb. Bran. 1·5 lb. Barley. 5·6 oz. Chalk. 0·2 pint Treacle.	5·60	*5·67*	9·3 lb. Sharps. 3·4 lb. Bran. 1·5 lb. Barley. 3·3 lb. Yeast. 5·6 oz. Chalk. 0·2 pint Treacle.
4	9·7 lb. Sharps. 4·8 lb. Bran. 4·7 lb. Yeast. 4·8 lb. Barley. 5·6 oz. Chalk. 0·7 pint Treacle.	*6·50*	4·07	14·4 lb. Sharps. 4·8 lb. Bran. 4·8 lb. Barley. 5·6 oz. Chalk. 0·7 pint Treacle.
5	15·5 lb. Sharps. 5·5 lb. Bran. 0·5 lb. Barley. 4·7 lb. Maize. 5·6 oz. Chalk.	7·11	*7·90*	10·5 lb. Sharps. 5·5 lb. Bran. 5·0 lb. Yeast. 0·5 lb. Barley. 4·7 lb. Maize. 5·6 oz. Chalk.

The average gains for the "yeast" lot in each period are printed in italics, and it will be noted that in every period without exception they are higher than the corresponding gains of the "no yeast" lot, although in Period 3 the difference is negligibly small. Taking the experiment as a whole, the average weekly gain obtained with the rations in which yeast was included was *6·13 lb.* per pig, whilst without yeast the average was *4·72 lb.* per pig, a difference over a period of 15 weeks of *1·41 lb.* per pig per week in favour of the yeast. Against this

must be set the increased cost of feeding where yeast was used, which amounted on the average to 1·18*d.* per pig weekly. In other words, the extra live weight obtained by using yeast was obtained at a cost of $\frac{1 \cdot 18}{1 \cdot 41}d.$, or $\frac{4}{5}d.$ per lb.

This result must be regarded as very favourable, and fully bears out the claims made that dried yeast is a very useful food for pig-feeding. It must not be taken as indicating that the yeast possesses special virtues which are not revealed by its composition as ordinarily expressed, since it is quite possible that other foods rich in albuminoids might have given equally good results. It can evidently be used successfully at present prices to supplement the more starchy foods widely used for pigs. Moreover, for pigs the bitter taste forms no drawback, since they will consume the yeast freely from the very outset.

No tests on experimental lines have been made at Garforth with other classes of stock, but calves to which dried yeast has been fed along with other food have taken to the food quite readily and have continued to make satisfactory progress, without showing any sign of digestive disturbance.

In the Garforth tests the food for the next day was mixed with water overnight and allowed to stand, whilst occasionally a few days' supply was prepared in advance. In no case did any appreciable fermentation take place, so that the vitality of the yeast cells is evidently completely destroyed in the drying process.

Summary.—Our experience with the food throughout the past winter may thus be summarised :—

1. Dried yeast has proved a safe food for cows, pigs, and calves.

2. For cows, dried yeast is not to be strongly recommended, since they show a special aversion to its bitter taste.

3. It has proved a good food for pigs, having given results markedly better than those obtained with an equal weight of wheat "sharps." Despite the increased cost of the ration on introducing dried yeast in the place of an equal weight of "sharps," the margin of profit on the feeding has been undoubtedly increased.

4. Dried yeast has proved a safe food for calves, but no evidence has been obtained as to its merits in comparison with other foodstuffs commonly used for calf-rearing.

5. Dried yeast keeps well, and on mixing with other meals and water may be kept for some time without objectionable fermentation taking place.

6. In arriving at these conclusions no account has been taken of the value imparted to the manurial excreta of the animals by the consumption of dried yeast. From its composition this may be expected to be as high as that of any other foodstuff commonly used on the farm.

7. Although the experience with dried yeast at Garforth, as outlined above, has been favourable, there is no reason to believe, either from the results of experiments or from careful observation of the general health of the animals throughout the tests, that the dried yeast possesses special medicinal or dietetic virtues which any other highly digestible food rich in albuminoids might not be expected to possess.

CHICKEN REARING AT MORDEN HALL, 1913-14.

AFTER the demonstration at Haslington Hall* was completed in the autumn of 1913, the Board, with the co-operation of the Cambridgeshire County Council, made arrangements for Mr. Paynter to continue his work in connection with the raising of chickens for the table at Morden Hall, Guilden Morden.

Morden Hall is situated about 3½ miles from Ashwell Station, and lies in a somewhat sheltered position close to the village of Guilden Morden. The greater part of the land originally included in the farm had been divided into small holdings, but there still remained 13 acres of meadow land, 5½ acres of orchard, the farm buildings, and a comfortable residence.

The grass land adjoins the farm buildings and is well sheltered; the soil is Greensand bordering on chalk, and is suitable for chicken rearing. The land had not been stocked with poultry for some time previous to the date on which Mr. Paynter entered into occupation. In addition to these advantages, the geographical position of Morden Hall was favourable to the object of Mr. Paynter's work, as it is situated near the borders of three counties where there are numerous small holdings.

The distance from a railway station was recognised as a drawback to the commercial success of the undertaking, but the many advantages of the situation commended it as a suitable place for the continuation of the trial.

* See *Journal* for March, 1914, p. 1049.

At the end of November, 1913, that part of the equipment which it was necessary to retain was removed from Haslington Hall, Crewe, to Cambridgeshire. While this involved a considerable amount of work, it was found possible, within a period of about four weeks, to dismantle the runs at Crewe and to re-erect the great majority of them at Morden Hall. No skilled labour was employed for this purpose, and the work was carried out by Mr. Paynter with the aid of an assistant. Four acres of the grass land were laid out in (1) runs suitable for chickens in the brooders, and (2) runs containing Sussex Night Arks to which the chickens were transferred at about the age of seven weeks, and in which they remained until marketed. The first batch of eggs was placed in the incubators on the 7th December, 1913. The general methods of incubation and rearing adopted by Mr. Paynter in 1913-14 were identical with those followed at Haslington Hall, and these methods have already been described in previous issues of the *Journal.** In arranging for the supply of eggs during 1913-14 Mr. Paynter determined to pay higher prices than he had given in the previous year, with the object of obtaining a larger proportion of pure-bred chickens, and, if possible, more satisfactory results in regard to the percentage of chickens hatched.

The method of disposing of the chickens during the past season was the same as that followed in the previous year, viz., the birds were despatched alive in weekly consignments to London, but about 48 birds from each weekly batch selected for sale were handed over to a fattener and were trough-fed and crammed. Particulars of the results of this trial will be found in a subsequent part of this article. When the war broke out it was considered desirable to retain a certain number of pullets for egg production. At that time there were in the runs about 1,500 pullets of ages varying from 6 to 16 weeks. These birds were neither the produce of bred for laying, nor were they hatched at a suitable season of the year for the production of winter eggs, but they formed a potential source for the supply of a large number of eggs, and it was decided to retain about 1,000 of them for this purpose.

These birds were transferred from the table chicken section to a laying section at the age of about 16 weeks, and the former section was credited with their value calculated at the price which was being received for the lean table chickens sent up to London.

The results of incubation during the season 1913-14 are set out in detail in Table I.

* Cf. *Journal*, June, 1914, p. 220; March, 1914, p. 1049; February, 1913, p. 902; and December, 1912, p. 721.

TABLE I.—*Statement of Eggs Incubated and Numbers of Chickens Hatched.*

Date.		No. of Hatch.	Bought.	Broken.	Infertile.	Not Hatched.	Chicks.	Cost of Eggs and Chickens.	Percentage hatched on total number of eggs incubated.	Percentage of chickens hatched after allowing for broken and infertile eggs.
December	7th	1	241	1	80	62	98		41	61
,,	14th	2	423	—	98	189	136		32	42
,,	21st	3	371	23	126	138	84		23	38
,,	28th	4	203	1	40	102	60		30	37
January	4th	5	148	2	27	58	61	*Total cost of eggs—£102 12s. 11d.*	41	51
,,	11th	6	360	3	78	188	91		25	33
,,	18th	7	414	—	87	157	170		41	52
,,	26th	8	295	34	54	112	95		32	46
February	2nd	9	396	7	68	141	180		45	56
,,	8th	10	412	6	73	173	160		39	48
,,	15th	11	384	3	71	150	160	Average cost of eggs per dozen—*2s. 1¼d.*	42	52
,,	22nd	12	434	—	85	204	145		33	42
March	1st	13	397	—	85	172	140		35	45
,,	8th	14	524	2	82	237	203		39	46
,,	15th	15	470	—	68	232	170		36	42
,,	22nd	16	492	1	83	180	210		45	54
,,	29th	17	516	—	71	205	240	Day-old chickens bought—*£1 7s. 6d.*	47	54
April	5th	18	345	—	28	120	197		57	62
,,	7th	19 (*a*)	156	1	12	60	83		53	58
,,	12th	19 (*b*)	325	2	27	126	170		52	57
,,	19th	20	401	8	36	171	186		46	52
,,	26th	21	342	—	70	109	163		48	60
May	3rd	22	442	—	68	147	227	Average cost of eggs per chicken hatched—*5¾d.*	51	61
,,	10th	23	380	—	63	157	160		42	50
,,	17th	24	378	—	42	152	184		49	55
,,	24th	25	352	3	51	146	152		43	51
,,	31st	26	370	9	66	147	148		40	50
June	7th	27	460	6	89	162	203		44	56
		—	10,431	112	1,828	4,206	4,285	—	Average 41.	Average 50.

The figures show that 10,431 eggs were purchased at a cost of £102 12s. 11d., or 2s. 4½d. per dozen, as compared with 9,897 in 1912-13 at a cost of £76 16s. 10d., or 1s. 10¼d. per dozen. Mr. Paynter therefore paid about 6d. a dozen more for his eggs in 1913-14 than in the former year. The proportion of chickens hatched from the total number of eggs passed through the machines is the same in both years, viz., 41 per cent., but when the broken and infertile eggs are omitted from the calculation the proportion of chickens hatched from the remaining eggs is 50 per cent. in 1913-14 as compared with 51 per cent. in the previous season. The average cost for eggs for each chicken hatched was 4½d. in 1912-13, while at Morden Hall in 1913-14 the average cost amounted to 5¾d.

The number of chickens sold or "taken over at a valuation"* amounted in 1913-14 to 3,549, as compared with 3,471 sold in the previous year, an increase of 78. The number of chickens which died or were lost in 1912-13 amounted to 557 (14 per cent.); in 1913-14 the losses amounted to 736 (17 per cent.).

These figures indicate that the additional cost of the eggs for hatching did not secure any higher percentage of chickens, a result which was anticipated as the eggs necessarily suffered as in the previous year from the effects of fairly long journeys by road and rail.

Local supplies were inadequate in quantity and not suited for the production of table chickens.

The advantage derived from the additional expenditure was found in the more uniform character of the birds as a whole; they were generally of a good table type and a large proportion of pure-bred chickens was secured, including Sussex, Faverolles, White Orpingtons and White Wyandottes.

The high percentage of birds recognised as suitable for table purposes among the chickens probably had a favourable effect; consignments were fairly uniform and this may have tended to increase the prices which were realised.

The average price per pound obtained for the "lean" chickens which were sold in 1913-14 was 9¼d., as compared with 8½d. in the previous year.

The cost of food was considerably reduced in 1913-14 despite the fact that during the last three months of the demonstration, that is from 1st August until 31st October, when the last birds were sold, the prices of feeding stuffs were very much higher. The cost of the food consumed was £248 13s. 10d.

* This valuation was always regulated by the market price obtained for strictly comparable consignments.

in 1913-14, and £275 7s. 5d. in 1912-13. In 1912-13, however, through unavoidable circumstances, one consignment of food was practically lost and represented in value a sum of not less than £10.

At the same time it should be noted that the average weight of the chickens sold at Haslington Hall was 4·024 lb., while the average weight of those marketed from Morden Hall was 3·900 lb. (see Table II.). In 1913-14 the average cost of

TABLE II.

Statement of Sales.

Date.		No. of birds.	Weight.	Value.		
			lb.	£	s.	d.
April	11th	48	183	9	0	0
,,	18th	48	179	9	0	0
,,	25th	64	229	12	0	0
May	2nd	24	91	4	4	0
,,	9th	66	250	11	10	6
,,	16th	68	240	11	17	6
,,	23rd	88	334½	15	8	0
,,	30th	89	349½	15	11	0
June	6th	110	413	18	17	0
,,	13th	128	499	20	16	0
,,	20th	161	604	26	3	3
,,	27th	146	552	23	14	6
July	4th	128	489½	19	14	0
,,	11th	107	405	16	1	0
,,	18th	121	458½	18	5	0
,,	25th	128	492	19	4	0
Aug.	1st	110	424	15	17	9
,,	8th	129	495	17	14	9
,,	15th	109	458½	14	19	9
,,	22nd	81	363½	11	2	9
,,	29th	69	299¾	10	2	3
Sept.	5th	77	328¾	9	19	5
,,	12th	49	197½	6	2	9
,,	19th	39	153	4	17	6
,,	26th	68	257	8	10	0
Oct.	3rd	35	142	4	7	6
,,	10th	48	204	5	17	0
,,	17th	42	173	5	5	0
,,	24th	61	259	7	12	6
Nov.	1st	52	221¼	6	10	0
,,	4th	34	132½	4	5	0
Total		2,533	9,878	384	9	8
In addition 1,016 chickens were retained in connection with the egg-producing scheme, their estimated value being				£131	4	6
Total value of chickens reared				*£515*	*14*	*2*

Average weight of chickens when sold .. 3·900 lb.
.. erage price received per pound .. .. 9¼*d*.

food consumed per bird sold was 1*s.* 4¾*d.* and the average price realised was 2*s.* 10¾*d.*; in 1912-13 the corresponding figures were 1*s.* 7*d.* and 2*s.* 10¼*d.*

The Profit and Loss Account (see Table III.) for 1913-14 shows a net profit of £45 11*s.* 4*d.*, and this figure is lower than that of the previous year, when the net profit was £55 1*s.* 2*d.* It would be entirely misleading, however, to assume that these two amounts are strictly comparable, or that during 1913-14 the commercial results were less satisfactory than in the former year. A comparison of the Profit and Loss Account for 1912-13 with that now published will indicate at once that a number of items are included on the debit side of the latter statement which were not charged in the former account, and that other items have been increased. Mr. Paynter has always maintained that if his methods are to yield an adequate return the necessary labour must be supplied by the small holder and his family, and consequently any entry for wages should in fairness to this condition be regarded as a return obtained by the small holder and the members of his family for their labour.

The wages of an assistant in 1913-14 amounted to £33 6*s.* and this item appears on the debit side of the account. In addition to this, depreciation of plant was charged at the rate of 7½ per cent. on £219 3*s.* in 1912-13; in 1913-14 depreciation was charged at 10 per cent. on £258 9*s.* 2*d.* and a considerable amount of the additional plant consisted of new appliances not absolutely necessary for the commercial success of the work. Thus, while the sum for depreciation was £16 8*s.* 9*d.* in 1912-13, it amounted to £21 13*s.* 3*d.* in 1913-14, an increase of £5 4*s.* 6*d.*

Capital was increased in 1913-14 by about £82 14*s.* 3*d.*, and the charge for interest was thereby increased by £2 10*s.* 10*d.*

No charge for repairs and renewals was made in connection with the 1912-13 account.

While, therefore, the profit and loss account for the 1913-14 demonstration appears to show a decreased net profit in comparison with that of 1912-13, the sums set down as net profit for the respective years are not strictly comparable. It is quite clear that if the item for wages be regarded not as the wages of outside labour, but as a return for the labour of the small holder and his family, the profit would amount to £78 17*s.* 4*d.*, a very considerable increase on that of the previous year.

The Profit and Loss Account (see Table III.) in connection with the season's work at Morden Hall has been drawn up as an actual statement, and not with any consideration of the

TABLE III.—*Mr. F. G. Paynter's Poultry Demonstrations at Morden Hall, Guilden Morden, Cambs.*

(1) *Lean Birds Demonstration. Profit and Loss Account*, 1913-14.

NOTE.—The 1912–13 Demonstration was completed on the 30th November, 1913. The 1913-14 Demonstration started on the 1st December, 1913, and was completed on the 31st October, 1914, and consequently covered a period of eleven months only.

DR.	£ s. d.	£ s. d.		CR. £ s. d.
31st October, 1914.			31st October, 1914.	
To Food consumed		248 13 10	By Chickens sold (1,454)	214 16 5
,, Eggs purchased		102 12 11	,, Chickens (1,070) taken over by Fattening Birds Demonstration at agreed valuation	169 13 3
,, Oil used		15 4 8	,, Chickens (1,016) taken over by Egg Production Demonstration at agreed valuation	131 4 6
,, Chickens (day-old) purchased ..		1 7 6	,, Manure sold	4 16 0
,, Chickens (5) returned by Fatting Birds Demonstration at agreed valuation		17 0	,, Eggs sold (from Pullets reared) ..	2 9 0
,, Repairs and Renewals		1 13 0		
,, Railway carriage and cartage ..		19 6 8		
,, Labour		33 0 0		
,, Rent, Rates and Taxes (proportion applicable to Lean Birds Demonstration)		11 10 0		
,, Miscellaneous Expenses		3 12 2		
,, Depreciation of Plant at 10 per cent. per annum :—				
£202 14*s.* 3*d.* for 11 months ..	18 11 8			
£55 14*s.* 11*d.* (Plant purchased during the year)	3 1 7	21 13 3		
,, Interest on Capital, £382 14*s.* 3*d.* for 11 months at 5 per cent. per annum		17 10 10		
		£477 7 10		
Net Profit		45 11 4		
		£522 19 2		£522 19 2

I have drawn up the above Account of the Lean Birds Demonstration at Morden Hall, Guilden Morden, for the eleven months ended the 31st October, 1914, and have examined the same with the book [illegible]d vouchers kept by Mr. Paynter.

(Signed) P. [illegible]ANGLEY,
[illegible]ssistant Accountant, Board of Agriculture and Fisheries.

13th February, 1915.

special circumstances which Mr. Paynter maintains to be necessary for the successful rearing of chickens on this system by the small holder. The figures in the account may, therefore, easily be misinterpreted.

From these figures it is fair to assume that had a small holder worked at Morden Hall with a family sufficient to supply the necessary labour the return he would have obtained from the season's work may not unfairly be represented by the net profit, plus the amount paid in wages and the amount deducted as interest on capital. His return for the season would then be £96 8*s.* 2*d.*, which represents 25 per cent. profit on the capital invested.

The results of last season's work emphasise the importance of the egg supply as a determining factor in the success of this method of chicken rearing. It will be noted from the figures which have already been given that every dozen chickens hatched by Mr. Paynter cost 5*s.* 9*d.* in eggs alone. This sum does not include carriage on the eggs or expenses of incubation.

The production of eggs for hatching in the immediate vicinity of the centre where they are required would probably considerably increase the percentage of chickens hatched, while the cost of providing the eggs could be reduced if stock birds were kept for the purpose on adjacent land. The percentage of losses during the past season was comparatively high, viz., 17 per cent., and may be accounted for to some extent by the depredations of hawks, which were very troublesome. The general health of the chickens was good, and accidents with the brooders were comparatively rare, although a few heavy losses were due to this cause.

Fattening Trial.—The test in regard to fattening chickens reared by Mr. Paynter, to which reference has already been made, was carried out with the object of ascertaining how far the increased price obtainable would justify the additional cost and labour of fattening.

Arrangements were made for the temporary employment of an assistant who had been trained in Sussex and who had several years' experience on rearing and fattening plants in that county.

Two very suitable sheds connected with the farm buildings were available. One was a long, open-fronted shed, facing the north west, in which the birds were trough-fed, and the other was a thatched shed with a cement floor in which there was a convenient means of regulating the amount of light

TABLE IV.—*Number, Weight, and Value of Birds when put into Fattening Pens and when sold.*

No. of Brood.	Number, weight, and value of birds put into fattening pens.					Number and weight of birds sold and prices realised.					Average increase in weight.
	Date when birds were put up.	No. of birds put up.	Average weight of birds when put up (fasted).	Value per head when put up.	Total value of birds when put up.	Birds sold during week ending.	No. of birds sold.	Average weight of birds when sold (fasted).	Total sum realised from sales of birds.*	Average *net price* obtained per bird.*	
			lb.	s. d.	£ s. d.			lb.	£ s. d.	s. d.	lb.
1	April 10	48	3·81	3 9	9 0 0	May 9	40	4·85	10 10 1	4 6¾	1·04
2	,, 17	48	3·77	3 9	9 0 0	,, 16	47	4·78	12 3 8	5 2¼	1·01
3	,, 25	48	3·56	3 9	9 0 0	,, 23	47	4·74	11 3 3	4 9	1·18
4	May 2	24	3·81	3 6	4 4 0	,, 30	24	5·31	6 11 4	5 5½	1·50
5	,, 9	48	3·83	3 6	8 8 0	June 6	47	5·09	12 2 5	5 2	1·26
6	,, 16	48	3·69	3 6	8 8 0	,, 13	47	5·18	11 18 7	5 1	1·49
7	,, 23	48	4·06	3 6	8 8 0	,, 20	47	5·62	12 18 11	5 6	1·56
8	,, 30	48	3·97	3 6	8 8 0	,, 27	48	5·04	13 13 6	5 8½	1·07
9	June 6	48	4·01	3 3	7 16 0	July 4	46	5·11	12 12 2	5 3	1·10
10	,, 13	48	4·43	3 3	7 16 0	,, 11	48	5·27	12 17 8	5 4½	·84
11	,, 20	48	4·26	3 3	7 16 0	,, 18	47	5·10	11 0 9	4 8¼	·84
12	,, 27	48	4·19	3 3	7 16 0	,, 25	48	5·25	11 7 10	4 9	1·06
13	July 4	48	4·07	3 0	7 4 0	Aug. 1	48	5·04	10 13 11	4 5½	·97
14	,, 11	48	4·12	3 0	7 4 0	,, 8	48	5·54	10 0 10	4 2¼	1·42
15	,, 18	48	3·96	3 0	7 4 0	,, 15	47	5·39	8 13 2	3 8½	1·43
16	,, 25	48	4·20	3 0	7 4 0	,, 22	48	5·43	9 5 8	3 10½	1·23
17	Aug. 1	48	4·20	2 9	6 12 0	,, 29	47	5·42	8 12 3	3 8	1·22
18	,, 8	47	4·15	2 9	6 9 3	Sept. 5	47	5·41	8 4 6	3 6	1·26
19	,, 15	48	4·33	2 9	6 12 0	,, 12	48	5·80	9 2 1	3 10½	1·47
20	,, 22	48	4·27	2 9	6 12 0	,, 19	46	5·68	8 19 0	3 10¾	1·41
21	,, 29	48	4·25	2 9	6 12 0	,, 26	47	5·50	8 11 0	3 7¼	1·25
22	Sept. 5	48	4·16	2 6	6 0 0	Oct. 3	48	5·40	7 13 0	3 2¼	1·24
23	,, 12	48	4·01	2 6	6 0 0	,, 10	47	5·54	8 2 9	3 5½	1·53
Total	—	1,080	—	—	169 13 3	—	1,063	—	236 18 4	4 5½	—

* Less carriage and commission.

admitted, and where the birds could be free from disturbance. This shed was used for the birds when crammed by machine. The necessary appliances in the shape of fattening cages, a cramming machine and other utensils were provided. The birds were fed in accordance with the usual practice of Sussex fatteners, and special attention was given to the selection and purchase of foods, so that the ground oats and sharps might be both good in quality and as fresh as possible. The food was stored in a separate shed where the preparation and mixing were carried out. Suitable accommodation was also available for preparing the birds for market. The consignments were packed in " peds " and were sold on commission in the London market.

On and after the 10th April (see Table IV.) about 48 birds were handed over to the fattener each week from the batch selected for marketing in the ordinary way, and they were charged against the account at the average price realised by the remainder of the consignment when sold.

During the period from the 10th April to the 12th September, 1914, 1,079 chickens of an average weight of 4·05 lb. were transferred to the fattening pens; the average price per bird was 3*s.* 1¾*d.* The birds were kept in the pens for about 21-25 days and the average increase in weight during that time was 1·23 lb. per bird which cost in food about 7*d.* to produce. The cost of food consumed amounted to £31 12*s.* 3*d.*, and, after deducting 5 birds returned to the lean demonstration and 11 birds lost, 1,063 chickens were actually fattened and sold. The 1,063 birds realised a gross sum of £257 3*s.* 8*d.* or an average of 4*s.* 5½*d.* per bird after deducting carriage and commission. Each bird, therefore, gave on the average when fattened a return over the cost of food of 8¾*d.*

In this connection it is well to call attention to the fact that, as compared with the average price paid by the higglers in Sussex for lean chickens, the prices at which the chickens were debited to the fattener in this trial rule high. In April, May and June the Morden Hall birds were, on an average, costing the fattener 3*d.* each more than similar birds obtainable for fattening at that time in Sussex, and probably this discrepancy in price was greater as the season advanced. This increase in the cost of the lean birds represents a very considerable reduction in profit, but for the purposes of this trial it was important to ascertain the result of fattening the birds when taken over at the prices which they would have realised as unfattened chickens.

TABLE V.

Quantity of Foods used in each week of the Fattening Period.

Week ending.		Ground Oats.	Sharps.	Fat.	Milk.	Grit.
		lb.	lb.	lb.	Tins.	lb.
April	17th ..	70	35	½	7½	5
,,	25th ..	150	76	6	8	5
May	2nd ..	179	71	10½	13	5½
,,	9th ..	143	72	6	17	2
,,	16th ..	231	51	7½	20	2½
,,	23rd ..	147	95	9	21	4½
,,	30th ..	243	65	11	25	1½
June	6th ..	270	83	13	25	7
,,	13th ..	279	108	14	27	4
,,	20th ..	272	88	11	24	2
,,	27th ..	227	101	10	27	6
July	4th ..	188	121	5	21	5
,,	11th ..	183	128	11½	8	5
,,	18th ..	215	122	6	20	1
,,	25th ..	186	123	7	26	4
Aug.	1st ..	187	155	10½	20	5½
,,	8th ..	191	153	11	22	2½
,,	15th ..	206	178	14½	23	6
,,	22nd ..	154	132	10½	20	13
,,	29th ..	186	174	26½	18	6
Sept.	5th ..	174	214	12	23	6
,,	12th ..	134	152	6	25	3½
,,	19th ..	174	167	10½	18	6
,,	26th ..	138	100	10½	21	4
Oct.	3rd ..	79	84	7	8	—
,,	10th ..	23	16	2	2	—
Total	..	4,629	2,864	249	489½	112½

TABLE VI.

Summary of Results.

Number of chickens put into fattening pens ..	1,079.
Average weight	4·05 lb.
Value per head	3s. 1¾d.
Number returned to grass pens	5
Number sold fat	1,063.
Average weight when sold	5·28 lb.
Average price obtained after deducting carriage and commission	4s. 5½d.
Average increase in weight	1·23 lb.
Weight of Food used :—	*Cwt. lb.*
Ground Oats	41 37
Sharps	25 64
Fat	2 25
Grit	1 0½
Milk	489½ tins.

TABLE VII.—*Mr. F. G. Paynter's Poultry Demonstrations at Morden Hall, Guilden Morden, Cambs.*

(2) *Fattening Birds Demonstration. Profit and Loss Account,* 1913-14.

DR.	£	s.	d.	CR.	£	s.	d.
31st October, 1914.				31st October, 1914.			
To Chickens (1,079*) taken over from Lean Birds Demonstration at agreed valuation	169	13	3	*By* Fat chickens sold (1,063*)	257	3	8
,, Food consumed	31	12	3	,, Chickens (5*) returned to Lean Birds Demonstration at agreed valuation		17	0
,, Railway carriage and cartage‡ ..	15	10	1	,, Manure sold	3	3	9
,, Labour	21	7	9	,, Feathers sold	1	2	0
,, Salesmen's commission	12	14	0				
,, Rent, Rates and Taxes (proportion applicable to Fattening Birds Demonstration)	2	0	0				
,, Miscellaneous expenses	1	11	9				
,, Depreciation of plant (£11 4s. 7d. at 10 per cent. per annum, part year only)		12	10				
,, Interest on Capital, £70 for 11 months† at 5 per cent. per annum	3	4	2				
	£258	6	1				
Net Profit	4	0	4				
	£262	6	5		£262	6	5

* 11 Chickens were lost by death, &c. † See Note on Lean Birds Demonstration Profit and Loss Account.
‡ Of this sum £7 11s. 4d. represents carriage on chickens.

I have drawn up the above Account of the Fattening Birds Demonstration at Morden Hall, Guilden Morden, for the eleven months ended the 31st October, 1914, and have examined the same with the books and vouchers kept by Mr. Paynter.

(Signed) P. J. LANGLEY,
Assistant Accountant, Board of Agriculture and Fisheries.

13*th February*, 1915.

There is another factor to be considered in estimating the results of this test, viz., that chickens prepared by Mr. Paynter's method are not—when selected for sale—"lean" chickens in the ordinary acceptation of that term, and it is doubtful whether they require the same amount of preparation as ordinary lean chickens. Some trials conducted in the autumn of 1914, while by no means conclusive, tend to suggest some modifications in the method hitherto adopted.

The wages of the fattener have also to be considered. The time occupied in dealing with 48 birds a week or a maximum of say 150 was comparatively short and it would probably have been possible for him to handle 120 birds a week. Therefore, the whole of his wages have not been debited to the fattening account (see Table VII.), but have been apportioned, and three-eighths of the total only has been charged to the account. The wages paid were necessarily higher than those which obtain for permanent employment. The results of the trial are interesting as affording actual figures in connection with a fairly large number of birds, and indicate that where the necessary experience, skill and labour are available, the fattening of chickens reared by this method is likely to yield a reasonable return.

It is quite clear that fattening is a special branch of poultry production involving considerable skill and experience, and one in which mismanagement may lead to very serious losses. The general Sussex practice of keeping the two branches of rearing and fattening chickens in the hands of separate individuals is undoubtedly sound, and suggests the importance of co-operation among small holders as the most promising means of success in producing finished table chickens. Few small holders outside certain well defined areas would possess either the knowledge or the experience required for successful cramming, and it is doubtful whether the results of trough feeding alone in the case of chickens prepared by this method would produce a degree of improvement commensurate with the trouble and expense. From the Profit and Loss Account in connection with this trial it will be seen that a small holder skilled in fattening would have obtained in return for his labour a sum represented by the net profit, plus the amount paid in wages, together with the deduction for interest on capital, *i.e.*, a total of £28 12*s.* 3*d.*

The labour involved in connection with this demonstration and trial was considerable, and the Board desire to record their appreciation of the conscientious thoroughness with which the work was carried out at Morden Hall during the period under review.

SUGGESTIONS FOR THE CULTIVATION OF CATCH CROPS AND HOME GROWN FEEDING STUFFS.

THE enhanced prices obtainable at the present time for corn, beef and other products, the high cost of feeding stuffs, the shortage of labour, and other circumstances must inevitably tend to some readjustment of existing agricultural methods and practices even if only of a temporary character. While an increased production of corn and potatoes is of the greatest importance, it is also very desirable that steps should be taken to ensure a larger supply of home-grown food for stock. It may be useful, therefore, to discuss briefly some of the ways in which an increased quantity of useful produce may be obtained without seriously disorganising the normal farming methods.

The relative cheapness of most artificial manures affords a ready means of profitably increasing the output of both arable and grass land. Judicious expenditure on inferior grass land would almost certainly result in both immediate and lasting benefit. In the case of arable land, moderate applications of suitable manures should not only result in bigger crops but cleaner land. Bare fallows should, as far as possible, be dispensed with, or where absolutely necessary, be replaced by bastard fallows. It may be desirable in some cases to modify the existing rotation. Much of our arable land is farmed on the Norfolk four-course system, which may result in the soil being without a crop for nearly as long a period as it is cropped; after corn crops, after roots, and after potatoes, the soil usually lies idle throughout the winter, and more than one crop per annum is seldom harvested from the land.

In the case of soils in wet or late districts more intensive cropping may be impracticable, although even in the northern counties the plan of sowing some clover along with oats has given profitable crops of late autumn fodder for sheep. In the southern districts of England successional cropping might well be more extensively followed. After early potatoes, after peas, and even after an early corn harvest, catch crops are often possible, and may prove invaluable by providing green food for stock in the late autumn, winter, and spring following. These catch crops would be specially useful when prolonged drought may have diminished the ordinary hay and root crops of the season. In districts which

are specially affected by dry, hot summers much less reliance should be placed on pastures and root crops than at present, and more attention should be given to the cultivation of other forage crops.

Poor crops of roots are much too common in the south, and on many farms it would be a distinct gain if a proportion of the root "break" were set apart for the growth of other green crops. When appropriate green supplementary crops are selected they need never be wasted, for they may be grazed, fed green, or made into hay or ensilage, as found convenient.

It is not generally realised that in many districts a mixture of corn and vetches, with perhaps a few beans for support, will produce about as much green food per acre as the average crop of roots. Converted into silage this mixed crop would yield a highly nutritious winter fodder. In a modern silo of the American stave pattern practically no waste occurs, and the somewhat elaborate precautions in regard to pressure and temperature, hitherto considered essential in connection with older methods of ensiling, may be largely disregarded. Filling may proceed at convenient opportunities, and no pressure other than that incidental to spreading the green stuff appears to be necessary.

In addition to supplementing or replacing roots in dry districts, silage, as has long been recognised, may prove a useful addition to hay in grass districts subject to a heavy rainfall.*

The special uses of the crops available for the purposes above referred to are briefly indicated in the notes which follow. The total number of suitable catch crops is considerable, so that in arranging a scheme of cropping for any particular district a selection can be made to suit the varying local circumstances of soil and climate.

Catch Crops.

Rye will usually prove most serviceable when sown in July or August. If sown before the end of August it is generally advisable either to cut or to graze the crop in October and allow the second growth to come in for the following April and May. When sown early, rye will grow too rank to stand over the winter if the grazing or cutting is omitted.

If in spring the rye is grazed or mown before the ear appears in the stalk, and the land is then well bush-harrowed and

* **Further information on Ensilage is given in Leaflet No. 9 (*Ensilage*).**

rolled, the rye will grow again and ripen into a grain crop. For this purpose the St. John's Day Rye, owing to its greater tillering capacity, is more suitable than any other kind, but it has been difficult to obtain seed of this variety in recent years.

It will usually be advisable to follow green rye with another green crop, *e.g.*, turnips, rape or kale. For green forage rye should be sown thickly, at the rate of at least 4 bushels per acre. Rye is a drought-resisting plant, is capable of growing at a high altitude, and succeeds on almost any class of soil. For the production of the maximum amount of forage, however, it is necessary that the land should be in good condition. Where the soil is poor a spring dressing of ½ to ¾ cwt. of nitrate of soda or some other nitrogenous manure should be applied.

Italian Rye-grass when sown very thickly in July or August is fit, under favourable conditions, to graze in late autumn. In the following spring it might again be grazed or left for early mowing. It starts growth early in spring, and, if encouraged by dressings of nitrogenous manures, will prove an excellent stand-by for dairy farmers who may be short of forage in the late spring months. On sewage farms, or where irrigation is possible, Italian rye-grass will afford several cuttings in a year. The usual rate of seeding is from 2 to 4 bushels per acre. With a view to providing early keep for ewes and lambs in spring, a few pounds of Italian rye-grass may be included in a clover seeds mixture. This practice is recommended for districts in which clover is apt to fail. On the other hand, there is a risk of injuring the succeeding wheat crop on some soils if the grain crop is not suitably manured.

Western Wolths Grass resembles Italian rye-grass, but grows faster and reaches maturity in about two months. It might be utilised as a means of filling up blanks in a thin clover plant, or for sowing after early potatoes for autumn grazing.

White Mustard grows very rapidly, and may be sown where turnips and mangolds have failed, or it may be broadcasted upon stubbles broken up by the cultivator or disc harrow. If 14-16 lb. of seed be sown per acre, with 1½ to 2 cwt. of superphosphate, there should be good sheep food in six weeks or less under the most favourable conditions. Sown as late as the end of August, mustard will usually yield good food by the end of November. If not required for sheep feeding the crop may, with advantage, be ploughed in as green manure. This crop does not stand a hard winter.

Brown Mustard is grown only for its seed. It thrives best on rich loam, and is often taken as the first crop after breaking up grass land, as it is not commonly attacked by wireworms.

The seed is usually drilled at the rate of 3-4 lb. per acre on a fine tilth in March or April and lightly covered. The crop is thinned out early in May. It is also frequently sown broadcast at the rate of 1 peck per acre. Harvesting takes place in September when the lower pods are beginning to turn brown; if delayed longer, seed is apt to be lost. The crop is commonly cut with a hook, and tied into sheaves or laid on the stubble in handfuls. It is usually ready for carting after 3 or 4 days of dry weather. The average yield is very variable, but a well-grown crop should produce about 25 bushels per acre; the cost of cultivation is low, and a good crop of mustard seed is a valuable one. Dry harvest weather is essential, and the crop is almost confined to the eastern and south-eastern counties.

Rape may be drilled in the old rows where mangolds or swedes have failed, or sown broadcast on stubbles broken up by the cultivator or disc harrow. It is usually unnecessary to single rape. If excessively thick, plants sown on the flat may be thinned by cross-harrowing. The usual seed rate is 3 lb. if drilled, or 5 to 6 lb. per acre if sown broadcast.* Rape may be sown at any time from April to August. If seed is sown in April the crop will be fit to feed off in August, and again later in the autumn. When sown in July, the crop will be ready for use in October and November. Rape is mainly grown as fodder for sheep, but it is also an excellent supplementary food for pigs and other stock.

Thousand-headed Kale, when drilled in July or August, well manured and afterwards singled, will under favourable conditions supply a valuable and very bulky food for both sheep and cows in early spring from March onwards. When sown in March, April and May the crop will be ready for use in October, November and December.

Thousand-headed kale has taken the place of rape in many districts, as it yields a heavier crop. It reaches its maximum development on good land after being singled, but in the ordinary course, when the crop is grown for autumn use, singling is by no means generally practised. It is extremely

* It is desirable that the seed should be large and well-filled, and of a good strain. The so-called "Giant" rape does not appear to be stocked as such by seedsmen, though rape is variously sold as "Giant," "Giant Essex," "Dwarf Essex," "Broad-leaved," and "Broad-leaved Essex" rape. The varieties or strains, however, are not distinguishable as seed. Farmers are recommended to secure rape seed from a thoroughly reliable source.

hardy, and is capable of resisting both frost and drought. The seed is drilled at the rate of 4 to 6 lb. per acre, or sown broadcast at the rate of 10 lb. per acre. In some parts of the eastern counties kale forms a part of the ordinary fallow crop, being sown in alternate rows with swedes and kohl-rabi. It affords food and shelter for lambs. The crop transplants well.

Marrow-stem Kale is said to be the result of a cross between thousand-headed kale and kohl-rabi. The stem is longer and thinner than that of kohl-rabi and is topped with a bunch of green foliage similar to that on thousand-headed kale. Stock readily eat both stems and leaves. One of the chief merits of this plant is its power of resisting drought. It is sown in the same way as turnips, from the middle of April till the end of June.

Hardy Green Turnips.—The Hardy Green Round Turnip is a variety of white turnip specially adapted for late sowing. It will continue to grow during open weather in winter. In Ireland this turnip is sometimes sown broadcast, when it grows up like rape, the tops for which the crop is chiefly grown being exceptionally abundant. The tops may be cut, or the crop may be pulled, and the entire produce fed to stock. If, when the crop is cut, care is taken to leave a small portion of the stem above the root tops, a second crop of tops is obtained. When cultivated in this way in Ireland hardy green turnips sown in June are fit to cut in September, and yield a second crop by the following February or March. The crop is more suitable than rape for light and poor soils. The seed should be sown broadcast by means of a seed "fiddle" at the rate of 4 to 5 lb. per acre, and rolled in. Moderately thin sowing is important, as, if sown too thickly, the crop is injured by frost.

Rye and Rape Mixed.—For a mixed crop of rye and rape a useful proportion of seed to sow is about 2½ bushels of rye and 2½ to 3 lb. of rape per acre. The rye may be either drilled or sown broadcast and harrowed in, and the rape afterwards sown broadcast and covered by rolling. In no circumstances should the rye and rape be mixed before sowing, as, if this were done, even distribution of the seed would be impossible, and the covering necessary for the rye would be altogether too much for the rape. It is often an advantage, especially on peaty soils, where rape grows very rapidly, to allow an interval of about a week or ten days between the sowing of the rye and the rape seed, in order to minimise the possibility of the rape smothering the rye.

Maize.—This plant is very easily injured by frost, and is not suited to cold or wet districts. In the warmer southern counties, however, where pastures are liable to fail prematurely, especially in dry summers, maize has proved most useful as a supplementary green food for stock. On good land, manured with dung and artificials, as much as 30 tons per acre of green forage may sometimes be grown. Seed of a suitable variety, *e.g.*, White Horse Tooth, should be ploughed in about the latter end of May, the seed being dropped either in every furrow or every alternate furrow. In view of the possible necessity for subsequent hoeing the narrower distance should be adopted only on clean land in good mechanical condition. The usual rate of seeding is about 2 bushels per acre. Attempts to ensile maize in this country have met with very fair success, and in view of the high feeding value of the crop and the heavy yields which may be obtained, it seems desirable that further attention should be given to this aspect of maize growing. In America maize is chopped up and stored in stave silos with complete success. (*See also* Leaflet No. 73, *Cultivation of Maize for Fodder.*)

Sorghum requires climatic conditions similar to those for maize. Two varieties, viz.—*Sorghum vulgare* and *Sorghum saccharatum*, may be successfully grown in the southern counties. Sorghum produces rather less forage than maize but is ready for cutting a week or two earlier. The usual rate of seeding is about 20 lb. per acre, and the seed is drilled in rows, 6 or 7 in. apart.

Buckwheat will grow on poor, light, dry soils in warm districts where other crops would yield little or no produce. Considerable tracts of such land are to be found in the south-eastern and southern counties of England. Buckwheat is also a useful crop on low-lying fens. It grows rapidly and may be sown from the middle of May to the middle of July, the earlier sowing being advisable for seed production, the later being more suitable for green manuring. For seed it should be drilled in rows 12 to 15 in. apart at the rate of 1 bushel per acre; for ploughing in green, 2 to 3 bushels may be drilled or sown broadcast.

Buckwheat produces a succession of flowers right into late autumn. The seed ripens at different times, but the crop must be harvested about the end of August or beginning of September before all the seed has had time to form, or the early seed would fall. In view of this peculiarity considerable care is required in harvesting. The yield varies

greatly, but from 3 to 3½ qr. per acre may usually be expected. It is a useful food for poultry and pheasants.

Crops Suitable for Replacing Purchased Feeding Stuffs.

The most expensive constituents of purchased feeding stuffs are the albuminoids. The foods which the farmer usually grows—corn, roots, and straw—are relatively poor in albuminoids, and are chiefly valuable for the carbohydrates which they contain; it is, therefore, necessary to purchase feeding stuffs rich in albuminoids, such as decorticated cotton cake and soy bean cake, to make good the deficiencies of home-grown crops. In view of the scarcity and high cost of most of the feeding cakes at the present time, it is desirable that farmers should endeavour to replace them, to some extent, at least, with those home-grown crops which contain most albuminoids, such as linseed, beans and peas, clover, and vetch hay or silage.

Linseed may be sown from mid-April to mid-May, at the rate of about 1½ bushels, or 78 lb., per acre, and the crop should be ready for harvesting in August. If well grown a crop of 10 cwt. per acre may be expected. Crushed linseed is specially valuable in the rearing of calves, and for mixing with starchy foods in the feeding of all growing and fattening stock. Full particulars regarding this crop will be found in Leaflet No. 278 (*The Growing of Linseed for Feeding Purposes*).

Beans form a highly nitrogenous feeding stuff. In the rations of dairy and fattening stock beans may largely replace cotton and linseed cakes. Beans are also most useful in feeding young growing animals and horses engaged in heavy work. An account of the cultivation of this crop is contained in Leaflet No. 268 (*The Cultivation of Field Beans*).

Peas.—Two species of peas are commonly cultivated, namely, the Field Pea and the Garden Pea. There are many varieties, differing in character of haulm, time of ripening, and colour and form of seeds. The seeds of the field varieties are generally grey or dun-coloured, and are mainly used for stock-feeding. Field peas are best grown upon light or medium soils containing a moderate percentage of lime. They may sometimes replace clover in the rotation, or they may be cultivated as a partial fallow crop or as a first crop after old ley. Three bushels per acre should be drilled in rows about a foot apart, on a well prepared seed-bed in February and March, and three or four hoeings are commonly required in the course of the growing season. The crop should be

cut when the lower pods are beginning to turn brown, and left loose on the ground. It is subsequently turned over a few times until ready to be cocked, after which it is stacked and threshed with as little delay as possible. Care is required in harvesting, as the seed is liable to be lost, especially in hot and showery weather. The average yield is about 32 bushels per acre.

In early districts, garden varieties of peas are grown in the field for picking green for culinary purposes in the latter end of June and in early July, after which the land may be fallowed until autumn or sown with a suitable catch crop. In later districts, or where green peas cannot be profitably marketed, the ripe seed is harvested.

Crimson Clover (*Trifolium incarnatum*) in its three varieties, early, medium and late, may be sown during August or early in September to come in for use successively in May and June. The chief value of *Trifolium* lies in the ease of its cultivation and the rapidity of its growth. It provides early grazing for stock, or a crop which can be cut for horses or cattle at a time when green food is scarce. It is best adapted for warm, loamy, and gravelly soils in mild and early districts, and is seldom sown on cold or late land, as autumn rains and severe winter frosts injure it. Immediately after the corn crop is removed the surface of the ground is broken up with drag or disc harrows, so that the necessary covering for the seed may be obtained without loosening the underlying soil. The seeds are sown on the scarified surface, after which the ground is lightly harrowed and firmly rolled.

It is absolutely essential that this crop should be sown on a firm and solid seed-bed. The rate of seeding varies from 15 to 25 lb. or more per acre, according to the nature of the seed-bed, the smallest quantity of seed being required where the conditions are most favourable for growth. Crimson clover is much used for filling up blanks in ordinary clover crops.

It is not suitable for hay, and should never be fed to stock after flowering has ceased on account of the liability of the hairs of the mature flower-heads to form hair balls in the intestines. This crop is more fully dealt with in Leaflet No. 182 (*Crimson Clover*).

Vetches may be sown in autumn for use in spring, or sown in spring for use in late summer and autumn. A proportion of wheat, rye, oats, or beans is usually sown at the same time to afford support to the vetches. On poor soils a mixture of oats and vetches usually gives a better return than oats

alone. On well-manured soils heavy crops of excellent fodder may be grown from a mixture of vetches and a cereal, with a sprinkling of beans for support. For soiling purposes or for ensilage it is usual to drill from 2 to 3 bushels of vetches per acre along with 1 to 1½ bushels of oats, wheat or rye, or a mixture of these. When required for hay a smaller proportion of vetches should be sown, as it is very desirable to prevent the vetches from lodging, and to grow a crop that can be stacked quickly. A useful mixture for a vetch hay crop intended to provide fodder for cattle or sheep would be 70 lb. of winter vetches, 2 to 2⅓ bushels of winter oats, and 1⅓ to 1½ bushels of winter wheat or 1½ to 1¾ bushels of winter barley, per acre. Beans should be omitted when hay is the object. From seeds sown in September or October a crop should be fit to cut by about the middle of the following June. A certain amount of judgment is needed in deciding when to cut the crop. If cut too young the vetches wilt and fall into dust; if left uncut too long the crop becomes fibrous and stock refuse it. The right time to cut is when the small seeds in the pods at the base of the plant are about half-formed.

The method of cutting and saving the vetch mixture is precisely the same as in the case of "seeds" hay, except that it is desirable to sweat the crop in the stack a little more. As the crop is cut at a time of year when the rainfall is usually low and the sunshine abundant no great difficulty need be anticipated in making it into hay. In wet seasons, however, it may be desirable to make silage.

After the removal of the vetch crop, the ground may be bastard fallowed, *i.e.*, ploughed or cultivated and left uncropped till sown with wheat in autumn, or it may be preferable in the interval to sow a suitable autumn catch crop.

Continuous Green Cropping.

A method of growing vetches and other green crops which might often be used is the following* :—The vetch hay break should be divided into three sections, A, B and C. As soon as Section A has been cleared of vetches it is prepared for rape which is sown in the latter end of June. Section B is subsequently sown with hardy green turnips (broadcast) in early July, and Section C with a mixture of rye and rape in late July. The first crop (A) provides useful fodder from September to mid-December, the hardy green turnips are used from mid-December

* Cf. articles on "Continuous Cropping" by T. Wibberley in the *Journal of the Board of Agriculture*, November and December, 1914.

to the end of February, and the rape and rye are consumed during the months of March and April, thus providing a continuous supply of green fodder throughout the winter. The rape used in September and October may be expected to yield a second crop in the following March, when it may be grazed off by sheep and lambs.

Substitutes for Roots and Concentrated Feeding Stuffs.

As compared with the ordinary method of root-growing the cultivation of winter-green crops (hardy green turnips, rape, etc.), involves a considerable reduction in labour. Broadcasting may take the place of drilling; on suitable soils in a suitable climate the crops may be eaten on the land, thus saving cartage of food and manure; the green stuff may be cut if necessary and be fed indoors in the usual way, or on an adjoining pasture.

In an experiment* conducted recently on the farm of Sir Horace Plunkett in County Dublin it was found that for winter milk production a daily ration consisting of—

14 lb. Oat and Vetch Hay,
14 lb. Meadow Hay, and
70 to 84 lb. Rape or Hardy Greens,

proved quite as useful as—

21 lb. Meadow Hay,
56 lb. Roots,
3 lb. Maize Meal, and
3 lb. Decorticated Cotton Cake.

It was estimated that the cost of the former ration was approximately half that of the latter.

The foregoing list is not intended to be exhaustive, but includes the most important of those crops which are suited for catch-cropping and providing home-grown feeding stuffs.

Manuring.

In many cases the residues from the manures applied to previous crops will suffice, but if these are considered insufficient, such dressings as the following will usually give good results :—

Green Fodders belonging to the Grass Family.—Top dressings of nitrate of soda or other suitable nitrogenous manure, at the rate of about 1 cwt. per acre, repeated if necessary.

Crops belonging to the Cabbage and Turnip Family (rape, kale, mustard), and also maize :—

* Cf. articles on "Continuous Cropping" by T. Wibberley in the *Journal of the Board of Agriculture*, November and December, 1914.

8 to 10 tons of dung .. .. .. 1½ to 4 cwt. superphosphate .. .. ¾ cwt. sulphate of ammonia, or 1 cwt. nitrate of soda.	per acre.

If dung is not available the quantities of artificials should be increased.

Crops belonging to the Pea Family (vetches, &c.):—

8 to 10 tons of dung per acre, or

2 to 3 cwt. superphosphate, or 2 to 2½ cwt. basic slag. 3 cwt. kainit (when available at ordinary prices; too dear at present).	per acre.

NOTES ON MACHINERY AND THE LABOUR SUPPLY.

W. J. MALDEN.

IT is often urged that the British farmer is slow to adopt the latest types of farm implements. While there may be some truth in this, it is not always because he fails to appreciate their value. For some kinds of work he may prefer the greater thoroughness and accuracy of hand labour, or it may be that with a sufficient supply of labour available it is more economical, taken in conjunction with other work on the farm, to have the work done by hand. It must be remembered, moreover, that some of the earlier forms of machinery failed to fulfil the claims made by the makers, and that many were tried only to be discarded in favour of the older forms. During the last few years, however, most of the types of farm machinery have been immensely improved, and farmers may now make use of them with every confidence that they may be depended upon to do the work efficiently and at relatively small cost.

In the past the introduction of farm machinery has always been intimately connected with the labour supply. Any abnormal migration of rural workers from the land has usually been followed by a large increase in the use of machinery. As the present War is likely to lead to an unprecedented shortage in both men and horses, farmers will do well to prepare for this by considering the possibility of making a more extensive use of the many labour-saving implements which are now available.

Agricultural Tractors.—Steam engines have been used in ploughing for over half a century, but this method of tillage has never quite fulfilled early expectations, and during recent years it has receded rather than advanced in popularity. As an auxiliary to horse implements, and as a means of breaking up large tracts of land in fine weather, there is no doubt that steam ploughs have proved valuable to the farmer, but they have a number of disadvantages. The excessive weight of the engines, their great cost and lack of adaptability to other work, and the number of men and horses required to supply them with water and coal, have all helped to render them unpopular. Their work, moreover, is somewhat rough and uneven for British farming.

The unpopularity of the steam plough is due also in some measure to the construction of the multiple plough on wrong principles. As designed at present there is not sufficient clearance between the bodies to allow farmyard manure or rubbish to pass through freely, and owing to the rigid body the plough does not readily enter hard land. It is often difficult to make a single body plough set in promptly when the ground is hard, and the difficulty is increased with the multiple plough. A further objection is that on land lying in ridges or furrows, or where the surface is irregular or uneven, good work is impossible. Hollows and furrows will only be lightly touched, while ridges will be torn unduly deep. Steam ploughing would be much more popular if implement makers would construct multiple ploughs with self-adjusting breasts or with breasts easily adjustable by the operator.

The petrol or paraffin-driven agricultural tractor has not been very much used for farm work up to the present. The early forms of this type of tractor were crude, often inferior in workmanship and lacking in reliability. Now, however, efficient motors have been placed on the market by firms whose reputation for good workmanship is a guarantee of durability, and it is probable that they will rapidly come into general use.

The agricultural tractor is at present taking two main forms, (1) A powerful machine capable of drawing several ploughs and suitable for large farms or for letting out on hire. This form would also be available for such heavy work as drawing the biggest threshing machines and for road haulage. (2) A smaller tractor capable of pulling fewer ploughs, lighter cultivators, binders, and mowing machines, and for driving small threshing drums, chaff-cutters, etc. This form would be suitable for farms of average size and could be used for much of the work

hitherto done by horses. Tractors of very small power are not practicable, as so much of the total power is taken up in travelling over the land, especially when it is soft or loose.

There seems to be little doubt that the tractor is more economical than horse power. The following figures are given as showing the actual costs of working of three different types of tractor which are now on the market. No. 1 is a 40 h.p. tractor which may be regarded as taking the place of the old type of steam-plough engine. Working from 4½ to 9 in. deep it will plough from an acre to an acre and a half of land per hour according to the depth of ploughing and the nature of the land. Assuming that 1¼ acres are ploughed per hour, the costs of working per day of 10 hours are :—

	Cost per day. £	s.	d.
Petrol, 2 gallons per acre at 1*s.* 3*d.* per gallon	1	11	3
Oil, 1 quart per acre at 1*s.* 6*d.* per gallon		4	8
Driver's wages at £2 per week		6	8
Ploughman's wages at 22*s.* per week		3	8
Interest on £550 at 5 per cent. per annum		1	6
Insurance			10
*Depreciation, 5 years' life : scrap value £50 ..		5	6
Repairs, based on experience, 3d. per acre		3	1
Cost per day	£2	17	2

Cost per acre—4*s.* 7*d.*

In addition to ploughing this machine will be available for threshing and general haulage work.

No. 2 is a tractor of light type, weighing only 37 cwt. It is of 24 h.p. and is suitable for practically all work on the farm. Its weight makes it well suited for light, quick haulage, and it will drive a 5 ft. threshing drum. Ploughing with this tractor costs from 4*s.* to 4*s.* 6*d.* per acre according to the nature of the work.

No. 3 is a steam agricultural tractor weighing 4½ tons. The engine is a compound one, with side by side high and low pressure cylinders ; the boiler (with 200 lb. working pressure per inch) is of locomotive type and will haul four furrows on stiff land. The tractor will cover 5 acres in the day and consume 1 cwt. of coal per acre. The following is the cost of working per day :—

	£	s.	d.
Depreciation, interest on capital and repairs, at 15 per cent. for 200 working days		6	0
Five cwt. of coal		6	0
Oil, &c.		1	0
Driver's wages		4	0
Ploughman's wages		3	0
	£1	0	0

This would work out at 4*s.* per acre.

* The working life would really be from 10 to 12 years, but 5 years are given to show the maximum cost.

It appears therefore that ploughing by mechanical means must be very much cheaper than by horse power. A further advantage of mechanical power is that there is no limit to the working hours and, if necessary, the work may be carried on throughout the night by the aid of a lamp. This is an important point, as by this means it is possible to make the best use of spells of fine weather.

Other Types of New Machinery.—A characteristic of modern farm machinery is the tendency to combine many different types of work in one machine. The cultivator is now also available as a ridging plough, horse hoe and grubber, with very little additional cost for attachments. With the addition of a seed box it may be utilised as a broadcasting machine. Until a few years ago combination implements and machines were looked upon with suspicion, but the mechanical principles now applied are much more efficient and the earlier failures are avoided.

One of the best examples of a complex machine in use on the farm is the combined clover thresher and cleaner. This machine performs many different kinds of work with perfection, and should be appreciated by all those who have used the separate threshing drum and rubber.

Another machine of great use to farmers is the seed cleaner, which has replaced the unsatisfactory methods of the seed cleaning floor and has assisted materially in raising the standard of purity of agricultural seeds.

Milking Machines.—Another branch of farming work which would benefit materially by the introduction of machinery is milking. For some years it has been increasingly difficult to obtain skilled milkers, and the present shortage in labour will make the problem a serious one unless the farmer can see his way to utilise the milking machine. Farmers will do well to overcome their former prejudices. The crude, early forms are now superseded and the later machines are much more efficient, and farmers may use them with the knowledge that they are more economical than hand milking. One of the chief objections to the older machines was that the impure air of the cowsheds was forced into the milk at each stroke of the pulsometer, with the result that the milk kept badly. This has been avoided in one machine now on the market, and many other objections have been removed in the later types of machines.

Mechanical power has also been applied to cream separating and it is now possible to obtain at a cost of £26 10s. a combined

separator and petrol engine on one stand. The separation is done by a ½ h.p. engine, separating 70 gallons per hour at a cost of 1½*d*. The engine can also be used to work the churn.

The machines, to which attention has been called, not only do cheaper but better work than can be done by hand. They are, however, only a few of the really efficient labour-saving machines which are now available, and provided he can make use of them the farmer need have no apprehension as to the effect of any shortage of labour.

TECHNICAL ADVICE FOR FARMERS.

ALTHOUGH the English farmer has usually a wide and extensive knowledge of the ordinary principles of cultivation and breeding, cases constantly arise in which his experience may usefully be supplemented by the knowledge of the specialist who has made a study of some particular branch of agriculture. The most obvious example of this occurs in the treatment of diseases of plants, the nature of which cannot usually be identified by the farmer. Many of these diseases lead to serious losses, and it is only to the expert that the farmer can turn for reliable information as to their prevention or treatment.

At a time like the present, when the values of crops, manures and feeding stuffs have altered so greatly, when changes occur from week to week, when new machines and implements are required and when practices more or less unusual are being adopted, even experienced farmers may wish to have the benefit of the knowledge gained by others.

Many, for example, who do not usually manure their corn crops must be asking themselves whether, in view of the high prices now ruling, and the very wet weather of the winter and early spring, it would not be desirable to top-dress wheat and oats, or even barley, and would be glad to profit by the experience of those who habitually use such manures as sulphate of ammonia and nitrate of soda as a spring top-dressing.

Advice on agricultural matters, moreover, is needed not only by the experienced, but also by the inexperienced cultivator and by the small holder who may not always have that knowledge of the best agricultural practice which it is assumed the practical farmer possesses. There are many facts or methods which are still not matters of common knowledge,

although known and accepted by well-informed agriculturists. Among them may be mentioned the economic uses of manures and feeding stuffs; the merits of particular strains of seeds; and the manufacture of different types of dairy produce.

During the past few years the Board have given much attention to means of providing advice for agriculturists, and they are gradually organising a system by which it is hoped to provide full and accurate information for all who desire to avail themselves of it.

The system is one which will take a number of years to develop fully; it is as yet in an early stage, and under ordinary circumstances it would have been preferable to delay reference to it until the arrangements were more complete; but if properly utilised the system is already capable of providing much assistance for agriculturists, and in view of the present need for employing every possible resource, some account of it is desirable.

For the purposes of agricultural education, the Board have divided England and Wales into twelve groups of counties, each group constituting a "province." The aim has been to secure for each county a staff of competent Instructors under a Chief Instructor or Organiser, and to provide for each province the services of a well-equipped University Department of Agriculture, or a College with a staff of expert teachers and investigators capable of undertaking consultative work in agriculture, and in such of the sciences as bear most directly on the work of the farmer.

Advice through the Staffs of Local Education Authorities.

In many counties in England and Wales, the Education Authorities have already appointed a county agricultural staff, the members of which are qualified to deal with enquiries relating to recognised agricultural practices. Wherever these appointments have been made the Organiser and his staff are now available for the purpose of supplying general advice on agricultural subjects, including dairying, horticulture and poultry-keeping.

In those counties in which a trained agriculturist is employed persons desiring advice should apply to him; he will either deal with the subject himself or refer the enquirer to some specialist who can help him.

Advice through the Staffs of Universities or Colleges.

In eleven out of the twelve provinces above referred to, arrangements have already been made by which the members of the staff of a university or agricultural college are available

for advising agriculturists. Further, with the aid of a grant from the Development Fund, in nine out of these eleven institutions the staff has been specially strengthened by the addition of one or more officers, known as Advisory Officers.

The special business of the Advisory Officer is to deal with enquiries, endeavour to ascertain the subjects within the province that require special study, investigate, or arrange for the investigation of, these subjects, keep in touch with the progress of agricultural research, and endeavour to ensure that new scientific discoveries do actually benefit the farmers of the province. The name " Advisory Officer " was selected as being a convenient one to distinguish the new members of staff, provided for by a grant from the Development Fund, from others members of the college staff. But while the Advisory Officer is specially charged with the duties above indicated, it should be clearly understood that he is only one of a group of trained men engaged in studying agricultural questions and assisting in providing advice for agriculturists.

It is everywhere recognised that the subjects now embraced under the general term " Agricultural Science " are much too wide to be properly dealt with by one man. Instead of the " consulting chemist " of last century, who answered, or was expected to answer, questions on every scientific subject, there must now be a group of specialists. The only method of securing efficient help is by a system of division of labour which requires every member of the staff of an agricultural college or university department to do his share. Neither the County Organiser nor the College Advisory Officer has any monopoly in the giving of advice, for both are charged with this duty, and the business of each is to see that the enquirer, whether small holder or large farmer, gets the best possible information which may be available.

In those counties in which no Organiser or other trained agriculturist has been appointed, questions should be addressed to the Provincial College.

Research Institutes.

Attention may be directed to another group of institutions which, although established for a different purpose, are of the greatest possible value in the scheme for providing advice now under notice.

Research Institutes are institutions set up, or assisted, by grants from the Development Fund for the purpose of making a careful study of certain groups of agricultural

subjects. For example, the existing station at Rothamsted was enlarged, and now studies questions bearing on the fertility of soils in a more comprehensive way than was possible formerly; at Cambridge a new Institute has been formed for studying the feeding of animals; the Board have recently fitted up at Kew a new Institute for studying plant diseases; another Institute is now being erected by them at Addlestone, Surrey, for investigating the diseases of animals; at Bristol there is an Institute giving special attention to fruit, and other horticultural questions; at Cambridge there is an Institute for breeding new crops. The whole subject "Agricultural Science" has in this way been divided up into sections, on which eleven Institutes are already at work. The information provided through these Institutes will reach agriculturists through the staffs of universities, colleges and counties, as well as directly through publications.

Live Stock Officers.

In connection with the scheme for the improvement of live stock, an officer has been appointed by the agricultural colleges in the same way as the agricultural advisers above referred to. These officers will be primarily responsible for the local promotion and administration of the Live Stock Scheme in their respective areas,* but they will also be required to give technical advice and assistance to local agriculturists, and to members of the county staff on questions relating to live stock.

Forestry Advisers.

England and Wales have been divided into five districts, and an expert forester has been attached to a teaching institution in each district for the purpose of advising applicants on all questions relating to the treatment of their woods. In certain circumstances the teaching institution may charge for this advice a fee not exceeding one guinea a day. Since there are only five Forestry Advisers it has not been possible to adhere to "province" boundaries.

Summary of Arrangements for Advice.

From the foregoing particulars it will be seen that the arrangements made by the Board contemplate, for all branches of the agricultural industry:—

(1) The supply of ordinary information and advice through

* *See* Leaflet No. 282 (*Associations for the Breeding and Improvement of Live Stock*), printed at p. 46.

the County Organiser on the general principles and practice of agriculture.

(2) The supply of advice on more difficult matters, and the investigation of local problems through the medium of expert advisers and other members of a college staff.

(3) Scientific research on agriculture and on diseases of plants and animals, with the object of improving the quality of the information available for agriculturists.

Each of these parts of the complete organisation is intended to supplement the others and to prevent waste of time and energy.

Information Supplied by the Board.

In cases in which difficulty may be experienced in getting advice locally the Board are prepared to advise on agricultural questions, and on the treatment of insect and fungus pests, but in view of the importance of local knowledge in dealing with most agricultural questions it is desirable that reference should, wherever possible, be made to the County Organiser or other agricultural instructor.

NOTE.—The foregoing article has been issued in leaflet form, and contains a schedule showing the name of the Agricultural Organiser or other officer in each county to whom enquiries may be sent, together with the addresses to which enquiries for the College Advisory Staff should be forwarded. The arrangements are not in all cases complete, and further appointments are being made as opportunity offers. In those cases where no Agricultural Organiser is shown enquiries should be addressed direct to the College. The leaflet may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

DANISH INVESTIGATIONS SHOWING HOW TUBERCULAR FOWLS INFECT PIGS.*

JOHN J. DUNNE.
Fyns Sprogskole, Odense, Denmark.

UNTIL quite recently it was generally assumed that tuberculosis was either transmitted to pigs by feeding them with the milk, or unpasteurised whey, obtained from tubercular

* Translated from the 28th Report of the Serum Laboratory of the Royal Danish Veterinary and Agricultural High School, Copenhagen. 28de. *Meddelelse fra den kongelige danske Veterinær og Landbohöjskoles Serumlaboratorium, København.*

cattle, or was conveyed through the natural excrement of such cattle.

During recent years, however, close observation of several isolated cases of tuberculosis has indicated that pigs may be infected with the tubercular disease affecting poultry and birds in general—*i.e.*, avian tuberculosis—and extensive investigations made by competent veterinary surgeons have now confirmed this view.

It may be mentioned at this stage that avian tuberculosis is chiefly abdominal; and the tubercles, in the form of yellowish white nodules, from the size of a grain of millet seed to that of a pea, may be observed in the liver, in the spleen, or in the mesenteric glands of the fowls.

At the beginning of May, 1912, Mr. Axel Petersen, Veterinary Surgeon, Ringsted, sent the mesenteries and internal organs of three pigs, belonging to the same herd, to the Danish State Laboratory for examination. The examination showed the liver, lungs and mesenteric glands to be tubercular, and it was found that bacteria from the mesenteric glands were identical in every respect with avian tubercular bacteria.

In order to throw further light on the matter seventeen cases of swine tuberculosis were investigated. Of these, in five cases the disease existed in the mesenteric glands and tonsils only, while in the remaining twelve the disease was more or less general. The results of the investigations revealed that nine of the animals were infected with avian tubercular bacteria (either exclusively or along with bovine tubercular bacteria), and the other eight exclusively with bovine tubercular bacteria. The five cases in which the disease was limited to the mesenteric glands and tonsils were found to be exclusively infected with avian tubercular bacteria, while the bovine tubercular bacteria were found in the cases in which the disease was general.

It was then decided to extend the investigations to a much larger number of cases from different parts of the country. The State Agricultural Laboratory requested several swine slaughtering companies to arrange for their veterinary assistants* to isolate and send to the Laboratory whatever tubercular mesenteries or tubercular tonsils came to their notice. In the course of time the Laboratory received a large number of the diseased organs, chiefly representing cases of tonsilar tuberculosis only, from different parts of Denmark. These diseased organs were carefully isolated; those of each animal

* Danish law requires an efficient veterinary surgeon to be on the staff of the slaughtering company.

were packed up separately and forwarded to the Agricultural Laboratory accompanied by information as to the extent of the disease amongst the animals on the farm from which the tubercular case originated, the age of the tubercular animal and the owner's name and address.

On examining the organs of a total of 118 tubercular pigs it appeared that 86 of them contained bacteria identical in every detail with avian tubercular bacteria, 28 contained bovine tubercular bacteria, and in the remaining 4 cases the bacteria deviated in form from both types, but in two cases closely resembled the avian type.

The results of the foregoing examinations show that the character of the disease varies in accordance with the type of tubercular bacteria by which the pig is attacked. An attack of avian tubercular bacteria is usually of a local character, while that of bovine tubercular bacteria is of a general character.

In order to investigate the conditions under which the disease may be transmitted from poultry to pigs the State Agricultural Laboratory applied to the owners, whose swine were found to be attacked by avian tubercular bacteria, for detailed information as to the health of their poultry and the extent to which they had come into contact with the pigs. Forty-nine owners furnished reports. Of these, thirty-six stated that tuberculosis amongst their poultry was general, and post-mortem examinations of fowls from fourteen owners confirmed this; in the remaining cases the owners failed to send dead hens for examination, but gave instead such detailed information of the character and progress of the disease as to leave no room for doubt with regard to its identity.

As for the remaining thirteen owners, they reported that there did not appear to be any particular disease prevalent amongst their poultry, although one or another of the fowls died occasionally. It was impossible to decide from their replies whether tuberculosis existed or not, but it should be borne in mind that the absence of any great mortality amongst poultry does not preclude the possibility of the existence of tuberculosis. The disease is slow in its development, as a rule, and infected poultry might remain unnoticed for a long period and yet be virulent infective agents. As avian tuberculosis establishes itself chiefly in the alimentary tract, the excrement of the tubercular fowls is highly contagious. The unsatisfactory character of the information furnished by the thirteen owners in question may have been due partly

to an insufficient acquaintance with the nature of the disease, but it may also have resulted in some measure from the fact that they did not wish it known that their poultry were tubercular. In any case the poultry could not be considered free from tuberculosis simply because the State Laboratory failed to establish the existence of the disease.

The conditions under which poultry and pigs were kept on many of the farms rendered it almost impossible to prevent infection of the pigs from tubercular poultry. In some cases the hen-roost was situated directly over the pig-sties, without any intervening boards to catch the droppings, so that the pigs had unlimited opportunity to eat the excrement of the fowls. In other cases the fowls were only allowed to roost over the sties during the winter season. In these circumstances it would be nothing short of a miracle for the swine to escape infection.

On most farms it is the custom to allow the young pigs to run with the poultry during the greater part of the summer, either in an enclosed yard or on a free range. This practice also contributes to the spread of the disease.

A number of owners stated that the poultry and pigs were kept quite separate, and that they could not understand how the disease was transmitted. These owners, like the thirteen already referred to, are unacquainted with the nature of the disease. Even the impossibility of all direct contact between the poultry and pigs does not preclude the transmission of the disease from tubercular poultry indirectly. The bacteria in the droppings of diseased fowls remain potent for a long period, either in the manure heap or in the soil, and the pigs while rooting around might readily become infected. Another probable source of contagion is from pigs bought at fairs or markets and added to the existing stock; such animals may come from farmsteads where tuberculosis exists, and, being infected when bought, may transmit the disease to the buyer's stock. The disease may also be transmitted by rats or mice.

On the whole the results of the investigations show that the overwhelming majority of the cases of mesenteric tuberculosis are of a local character and almost exclusively due to avian tubercular bacteria.

The Laboratory also ascertained the number of cases of swine tuberculosis that occurred during 1912 amongst the animals of those owners whose poultry were ascertained to be tubercular, but as nothing is known of the health of the

cattle belonging to these owners it would not be fair to quote the figures. The following cases of tuberculosis which have occurred at Remkolde, where bovine tuberculosis no longer exists, are, however, on a different footing, and may be entirely attributed to contagion from tubercular fowls.

Table showing number of tubercular swine found on five farms where the poultry were tubercular and the cattle free from bovine tuberculosis and inoculated bi-annually.

	Number of pigs delivered during 1912.	Number of these found to be tubercular.	Percentage of tubercular animals.
Owner A	29	6	21 %
,, B	24	4	17 %
,, C	22	4	18 %
,, D	49	3	6 %
,, E	39	14	36 %

The above figures indicate the necessity for taking drastic measures to eradicate avian tuberculosis. The percentage of tubercular cases in the above table is unusually high, and although the disease in most cases was not of an acute form, a pecuniary loss resulted to the owner in every case, owing to the stringent Danish regulations as to the movement of, and the sale of meat* from, tubercular animals, however slightly tainted by the disease.

In two cases where the existence of avian tuberculosis amongst the swine was detected, the owners disinfected the sties and the hen roosts and carefully isolated the animals, with the result that the swine reared under the new conditions were found to be entirely free from the disease. Prior to taking these precautions, two or more animals in every lot were found to be suffering from tuberculosis; but no cases have occurred since the isolation took place. It appears, therefore, that the infection of pigs with avian tuberculosis can be prevented most effectively by isolating the pigs and the poultry, and taking drastic measures for the eradication of the disease amongst the latter.

* Tubercular meat, however slightly tainted, is rigidly excluded from export.

Associations for the Breeding and Improvement of Live Stock.

A GRANT for the purpose of improving the live stock of England and Wales was made to the Board from the Development Fund in 1913. The amount available was approximately £40,000, and it is anticipated that similar grants will be made for some years to come. The grant is intended to enable the Board to assist groups of farmers, especially the smaller farmers, to obtain the use of high-class bulls, stallions and boars instead of the inferior sires which are very generally employed at present. The Board will also be enabled to pay one-half the expenses (up to a certain maximum) of associations of farmers who undertake to keep milking records of their cows.

In order to impress upon farmers the advantages of co-operation in securing the services of good sires, grants in respect of stallions and boars will be made only to clubs and societies. The same procedure will also be followed wherever possible in the case of bulls, but in districts where bull societies cannot be formed, grants will also be made to individual breeders who are willing to place approved bulls at the disposal of their neighbours.

Grants will be made preferably to societies specially formed to take advantage of the scheme, provided that they adopt rules which conform substantially to those issued by the Board, but grants may also be made to existing bull, stallion and boar societies on condition that their rules are amended where necessary. Registration of societies (under the Industrial and Provident Societies Act or the Friendly Societies Act) is not essential.

Preference will be given by the Board, in the assistance offered, to occupiers of agricultural holdings, which either do not exceed 100 acres in extent, or if exceeding 100 acres, are of an annual value for purposes of income tax not exceeding £100.

A further advantage to farmers under this scheme is that they will be able to obtain practical advice and assistance on questions relating to live stock from the Live Stock Officers, who have been appointed by the selected agricultural institutions for the purpose of promoting the Live Stock Scheme in England and Wales.

The following are some of the more important conditions on which the grants for the provision of bulls, stallions and boars, and the grants to milk recording societies will be made

Grants for Bulls.—Grants for the provision of bulls will be made on the following conditions :—

(1.) No grant exceeding £12 per annum is to be made to any individual bull owner, or exceeding £15 per annum to any society in respect of any one bull.

(2.) Not more than four annual grants of £12 are to be made to any individual; and not more than five annual grants of £15 to any society for each approved bull provided by it.

(3.) Grants are only to be made to individuals when the Live Stock Officer in the area concerned is satisfied after full inquiry that it is not possible to form a bull club for a district in which the provision of a good bull is necessary.

(4.) No grant is to be made to any individual in respect of a bull previously owned by him unless the Live Stock Officer is satisfied that in return for the grant the bull can and will be made available for an appreciably greater number of cows belonging to small farmers than it now serves.

A society may provide a bull for the use of its members—

(*a*) By purchasing a bull and placing it in the custody of one of its members ; or

(*b*) By arranging with an owner of a bull—whether he be a member of the society or not—to place a bull at the disposal of the society on terms agreed between them.

If a society arrange to purchase a bull, it will be necessary to provide, by means of contributions from members or donations to the society, sufficient capital to defray the cost of the purchase of the bull, and also an annual income sufficient to cover the insurance and keep of the bull, the salary of the secretary of the society, the general expenses of management, and sinking fund charges in respect of the depreciation of the bull sufficient to provide for the replacement of the bull when necessary.

If a society arrange with an owner of a bull to place a bull at their disposal they must guarantee the service of not less than 25 cows belonging to their members.

The owner of a bull will be entitled under these circumstances (1) to a payment from the society of a sum not exceeding £12 as may be agreed upon, (2) to a fee of not less than 2*s.* 6*d.* for each cow served, and (3) to have not more than 15 of his own cows served by the bull.

If a society arrange for the provision of a bull in this manner, the grant of £15 made to them by the Board, together with a nominal subscription of say 1*s.* per member, would probably

suffice to defray all expenses, as the owner of the bull and not the society will be responsible for the keep, insurance, and care, &c., of the animal.

Grants to Heavy Horse Societies.—Grants will be made on the following conditions to heavy horse stallion societies which hire stallions :—

(1.) No grants will be given to societies which hire stallions to travel at a fee exceeding £3 3s.

(2.) In no case will the grant to a society exceed £80 for each approved stallion provided by it, of which not more than £40 may be a direct grant, the remainder being utilised, if necessary, for "assisted nominations."

(3.) Except in the case of "assisted nominations" no reduction in the amount of the service fee usually charged is to be made by the societies receiving grants.

(4.) The stallions hired by societies receiving grants must be registered under the Board's scheme for the registration of stallions ; and the mares for which assisted nominations are given must be approved by the society as suitable for the purpose.

The value of an assisted nomination is not to exceed half the amount of the service fee.

Grants for Boars.—Grants will be made to societies only.

The amount of the grant for a boar will be £3 per annum.

A society may provide a boar for the use of its members :—

(*a*) By purchasing a boar and placing it in the custody of one of its members ; or

(*b*) By arranging with an owner of a boar—whether he be a member of the society or not—to place a boar at the disposal of the society on terms agreed between them.

If a society arrange to purchase a boar it will be necessary to provide, by means of contributions from members or donations to the society, sufficient capital to defray the cost of the purchase of the boar, and also an annual income sufficient to cover the insurance and keep of the boar, the salary of the secretary of the society, the general expenses of management, and sinking fund charges in respect of the depreciation of the boar sufficient to provide for the replacement of the boar when necessary.

If a society arrange with an owner of a boar to place a boar at their disposal, they must guarantee the service of not less than 20 sows belonging to their members.

The owner of a boar will be entitled, under these circumstances, (1) to a payment from the society of a sum not

exceeding £3 per annum as may be agreed upon; (2) to a fee of not less than one shilling for each sow served; and (3) to have not more than 6 of his own sows served by the boar.

If a society arrange for the provision of a boar in this manner, the grant made to them by the Board, together with a nominal subscription of say 6*d.* per member, would probably suffice to defray all expenses, as the owner of the boar and not the society will be responsible for the keep, insurance and care, &c., of the animal.

Grants to Milk Recording Societies.—Grants will be made annually to societies whose members record the milk yields of their dairy cows not less frequently than once a week, and who employ a recorder to pay surprise visits to check, at least once every six weeks, the records taken. The amount of the grant will be half the expenses of the society up to £50 in respect of each whole-time recorder employed for every 20 herds in the possession of members of a society.

Further information as to milk recording societies, together with the text of the model rules and regulations issued by the Board, will be found in Leaflet No. 146 (*The Value of Records of the Milk Yield of Cows*).

NOTE.—A society or private individual desiring a grant under this scheme should address the application to the Live Stock Officer for the province in which the society or individual is located.

Detailed information as to the Board's scheme for improvement of live stock, and copies of the Board's model rules and regulations as to the award of grants to bull, boar, heavy horse and milk recording societies may be obtained, free of charge, on application to a Live Stock Officer or to the Secretary, Board of Agriculture and Fisheries, Craven House, Northumberland Avenue, London, W.C.

The foregoing article has been published in the form of a Leaflet (No. 282) of which copies may be obtained free of charge, and post free, on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. The Leaflet contains a list of institutions, the counties served by them, and the names of Live Stock Officers to whom enquiries for information as to the working of the Scheme in the respective provinces can be addressed.

Larch-Shoot Moths.

It is only within comparatively recent years that the small moths known as "larch-shoot moths" have been recognised as a source of injury to larch in this country. They are now known, however, to be widely distributed, and under certain conditions, which will be dealt with subsequently, are capable of causing serious loss.

The species occurring in England is usually known as *Argyresthia atmoriella*, though in the edition of the Board's leaflet, No. 208, of February, 1909, it was referred to as *Argyresthia laevigatella*, a Continental form not recognised with certainty as British. There is also an insect known on the Continent as *Argyresthia zelleriella*. These three names refer to moths with similar habits, but whether they should be regarded as a single species remains to be decided. The question is not of great importance from the forestry point of view, but at the same time it should not pass unnoticed, since these insects may be mentioned in literature under any one of the three names, a possibility apt to lead to confusion.

Description of Insect.

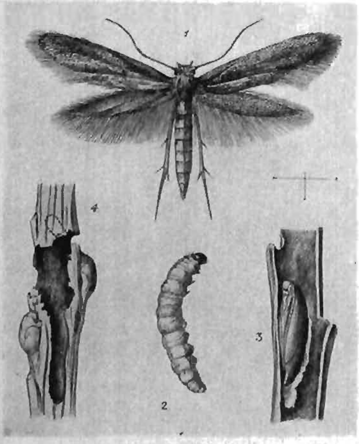
Adult Insect.—The moth measures about $\frac{1}{6}$ in. in length and about $\frac{3}{8}$ in. in spread of wings. Its general appearance when magnified is shown by Figure 1. The colour is leaden grey, the fore-wings having a distinct metallic gloss, while the hind wings are darker and without the gloss.

Larva.—The larva of *A. atmoriella*, when full grown, measures from $\frac{1}{5}$–$\frac{1}{4}$ in. in length and is shown, much magnified, in Figure 2. It has a black head and the body is either greenish or yellowish in general colour.

Pupa.—The form of the pupa is shown by Figure 3, which illustrates a specimen in position in a larch shoot. It is pale ochreous brown in colour.

Life History.

The moths appear at the end of May or early in June and lay their eggs on the young shoots, one egg as a rule being placed on each shoot. On hatching, the young larva bores its way through the cellular skin, under which it begins to feed. At first, owing to its small size, it does little damage, and the shoot is not sufficiently injured to prevent a normal development. As the larva grows it enlarges its burrow, causing



Larch-Shoot Moth (*Argyresthia atmoriella*).
Fig. 1.—Moth (magnified) Fig. 2.—Larva (much magnified).
Fig. 3.—Pupa. Fig. 4.—Form of Burrow.

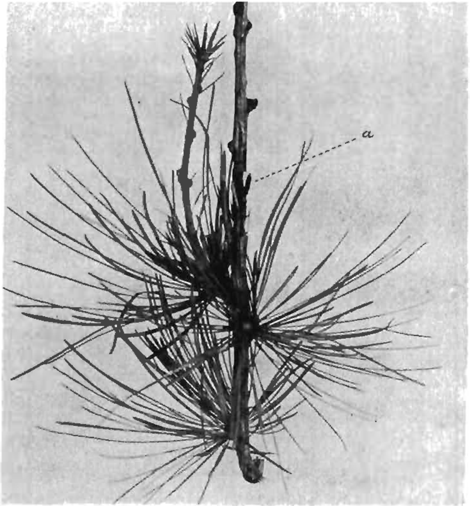


Fig. 5.—Branch of Larch attacked by Larch-Shoot Moth.
(*a*) Portion tunnelled by Larva.

more damage to the shoot, and by the end of March or beginning of April it has devoured the tissues right down to the wood, forming a tunnel which may be roughly described as an incomplete spiral,—that is to say, the shoot is almost if not completely ringed. The general form of the burrow is shown by Figure 4, which represents an attacked shoot, much magnified, from which the bark has been removed in order to show the workings of the larva underneath. The dotted lines indicate the continuation of the burrow on the under side of the twig. In May the larva is full fed and it then bites a small hole through the bark from which the moth will ultimately escape. This flight hole and a portion of the burrow are covered by a thin web and the larva then pupates, as is shown by Figure 3. On emerging the moth forces its way out through the silk covering over the hole, the empty pupa skin remaining in the burrow.

Plants Attacked and Nature of Damage.

The plants attacked by the pest comprise only those of the genus *Larix*, but whether, or to what extent, species other than the European larch are affected, is not at present known.

The nature of the damage is fairly obvious from the preceding description of the life history. The attacked twigs are almost ringed at the end of their first year and must naturally die, though a few needles may be produced from the lower portion near the flight hole. As a rule the leading shoot is not attacked, but in severe cases this may also occur. Diagnosis of an attack is not always easy, though the absence of needles on the lateral branches gives the tree a characteristic appearance. Dead shoots which have not been attacked by the insect are often numerous on larch, and the presence of the pest must always be confirmed by the discovery of larval burrows. Small birds seem to have no difficulty in recognising tenanted shoots, which they break open in order to obtain the larvae, and the traces left by the birds are often the most noticeable indication of an attack. Figure 5 represents an attacked branch, letter *a* indicating the region tunnelled by the larva of the *Argyresthia*. The branch is of interest as showing the development of a secondary shoot to replace that killed by the pest. It is, however, some-

Distribution and Economic Importance.

As regards the economic status of the insect, though it appears to exist wherever larch is grown, observations show that it is chiefly destructive in localities not altogether suited to this tree. It must probably be regarded therefore as one of those minor pests which only become of serious importance in plantations enfeebled by other pests, by bad culture, or by an unsuitable environment.

Methods of Control.

The preceding notes show that this pest is best controlled by restricting the planting of larch to localities suited to it.

No treatment can be suggested in the case of an extensive attack, but when a few trees only are affected in an otherwise sound plantation it would be a wise precaution to remove the attacked trees and burn the lateral branches. In the case of single trees of special value or in the nursery it might prove feasible to remove only the attacked twigs. This must be done as soon as failure of the twigs to produce needles in the spring shows that they have been attacked.

Present Comparative Values of Feeding Stuffs.

THE following notes on feeding stuffs have been prepared at the request of the Board by the School of Agriculture, Cambridge University. The values are based on the approximate prices of the various feeding stuffs at London, Liverpool, Hull and Bristol at the beginning of April.

The high prices of feeding stuffs, and the difficulties of transport, caused by disturbances due to the War, entail a very considerable amount of study on the part of the "feeder," who, looking for the most profitable results, wishes to fulfil the duty of increasing the national food-supply.

Food Constituents.—The skill of the chemist has enabled him to arrange all food constituents in groups, among which the following are very important: (1) Flesh-formers (called albuminoids or protein); (2) Carbohydrates (material used as fuel in the animal's body); and (3) Oil or Fat (a material which adds greatly to the value of milk and meat as human food, when stored as reserve concentrated fuel in the tissues of the "finished" animal). It should be fully realised that whereas fat can replace carbohydrates and carbohydrates can replace fat, neither the one nor the other nor both together can replace flesh-formers. Hence the importance of paying attention to the first column in the table on p. 55. Here, under the title

"Nutritive ratio," is stated the relative proportion of flesh-formers to fuel and fat. For instance, in the case of soy bean cake each 1 lb. of flesh-former is combined with $1\frac{1}{10}$ lb. (1 : 1·1) of fuel and fat (the fat being reduced to its full fuel value), whereas in the case of palm-nut cake 1 lb. of flesh former is combined with 4 lb. (1 : 4) of fuel and fat. This nutritive ratio should always be kept in mind when examining the cost of a feeding stuff.

*Food Units.**—For the purpose of comparing the value of one food with another chemists have sought to reduce everything digestible to one common factor, so that foods may be compared with one another. The chemist would be the last person to claim that this valuation is complete, and the matter is still being very closely investigated by scientific workers. Nevertheless, the results so far obtained are much too valuable to be ignored. A feeder may feel quite safe in allowing himself to be guided largely by them, provided always he pays attention to the following matters incidental to their *practical* worth.

Wholesomeness.—Occasionally the food unit value of a food is upset by the presence of some poison, but this is of very rare occurrence. At the same time, when circumstances suggest the desirability of using some feeding stuff that is new to the market it is undoubtedly desirable to bear the question of poisonous substances in mind.

Apart altogether from the presence of poisonous properties, experience suggests that stock thrive better on certain foods than on others. Linseed cake, oats and bran immediately suggest themselves to the mind as foods which are believed to be perfectly wholesome. The skill of the feeder must decide how much he ought to pay for the quality of wholesomeness. For instance, if the table on p. 55 be consulted the food unit of oats will be found to vary in cost from 2*s.* $11\frac{1}{4}$*d.* to 3*s.* $3\frac{1}{4}$*d.*, whereas that of maize germ meal lies between 1*s.* $7\frac{3}{4}$*d.* and 1*s.* $8\frac{1}{2}$*d.* The difference in the nutritive ratio is very slight, so that unless experience shows in no uncertain way that oats, in their effect on the health of the feeding beast, are quite different from maize germ meal, the former is a very much dearer food at present prices.

Prejudice.—In studying food unit values the feeder will do well to watch for any accidental cause that may have led to feeders disliking some particular foodstuff. For instance, decorticated cotton cake is disliked by many because, before knowledge about nutritive ratios was as common as it is now,

* Calculated by the formula protein % × $2\frac{1}{4}$ + fat % × $2\frac{1}{4}$ + carbohydrates % = food units per ton. (*See* Leaflet No. 74, p. 8).

it was fed in far too large quantities. Again, if maize be *substituted* for beans the result will be likely to be bad, whereas a *mixture* of maize and decorticated cotton cake would probably be successful in replacing beans as a fattening food.

Palatableness.—It is clear that stock exhibit preference in regard to food, but this preference should not be allowed to become too costly. The unrelished food should be given at the beginning rather than at the end of the feeding period. Its palatability can be increased by skilful mixing, by the addition of some little condimental food, and even by adding a little common salt.

Change of Feeding Stuffs.—Much of the prejudice which exists against the wholesomeness, the palatability, etc., of certain foods, is due to neglect of the elementary rule that all change in feeding stock should be gradual. This precaution is all the more important if foods differing greatly in their nutritive ratio are being substituted one for the other.

Convenience.—No practical feeder can neglect the matter of convenience, which is still more important when labour is short. Generally speaking, cake is more convenient to feed than meal, but experience of the special circumstances existing in each case must decide how much should be allowed for convenience in the cost of a feeding stuff.

Appearance.—Probably the pleasing appearance of a food is sometimes paid for. This indeed seems to be the case when the prices of the two wheat brans given in the table are compared, "broad" bran costing from 1*s.* 9¾*d.* to 2*s.* 0¾*d.* per food unit as against 1*s.* 7¼*d.* to 1*s.* 10¼*d.* for simple bran. Many practical men, who observe things for themselves, refuse to pay the extra money, however much more pleasing may be the appearance of the one compared with the other.

Markets.—The study of the table on p. 55 shows that locality may have a great effect on the cost of each food unit fed. For instance, oats cost 2*s.* 11½*d.* at Hull and 3*s.* 3¼*d.* at Bristol. If it may be contended that such a difference may be due to the special quality of a sample from the one or other locality, it can hardly be maintained that (see table) peas from Liverpool at 3*s.* 2½*d.* per food unit are as good value as peas from Hull at 2*s.* 6½*d.*

Remarks on Use of Feeding Stuffs.

The chief points in the feeding of the foodstuffs dealt with in the table are given below, and should be read in conjunction with the Special Leaflets Nos. 8, 16, 19 and 20 already issued by the Board. It is assumed that the usual allowance of roots and bulky fodder is fed.

Table of Feeding Stuffs, showing Nutritive Ratio, Food Units, Price per Ton and Price per Food Unit.

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate price per ton at the beginning of April.				Approximate price per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya Bean Cake	1 : 1·1	122·3	8 10 0	8 15 0	8 2 6	8 7 6	1 4¾	1 5¼	1 4	1 4⅜
Decorticated Cotton Cake	1 : 1·3	126·3	9 15 0	10 2 6	—	8 17 6	1 6½	1 7¼	—	1 4⅞
Indian Linseed Cake	1 : 1·9	123·1	10 10 0	10 15 0	—	—	1 8½	1 9	—	—
English Linseed Cake	1 : 2·0	120·1	10 15 0	11 15 0	10 10 0	11 7 6	1 9½	1 11½	1 9	1 10¾
Bombay Cotton Cake	1 : 2·4	65·3	6 5 0	6 7 6	6 15 0	6 10 0	1 11	1 11½	2 0¾	2 0
Egyptian Cotton Cake	1 : 2·0	71·9	6 10 0	7 0 0	7 0 0	6 15 0	1 9¾	1 11⅜	1 11⅜	1 10½
Coconut Cake	1 : 3·8	102·6	7 2 6	7 15 0	—	—	1 4¾	1 6	—	—
Palm-nut Kernel Cake	1 : 4·0	83·5	6 15 0	6 5 0	—	—	1 7⅜	1 6	—	—
English Beans	1 : 2·6	99·5	9 5 0	10 5 0	9 0 0	—	1 10¼	2 0¾	1 9¾	—
Chinese Beans	1 : 2·6	101·2	10 10 0	10 15 0	—	—	2 1	2 1½	—	—
English Maple Peas	1 : 3·2	97·2	12 13 0	15 11 0	12 5 0	—	2 7¼	3 2⅜	2 6¼	—
English Dun Peas	1 : 3·2	97·2	11 2 6	13 11 0	10 0 0	—	2 3½	2 9½	2 0¾	—
Calcutta White Peas	1 : 2·3	97·5	14 10 0	—	—	—	2 11¾	—	—	—
American Maize	1 : 11	93·8	8 12 0	8 12 0	—	—	1 10	1 10	—	—
Argentine Maize	1 : 11	94·2	8 3 0	8 6 0	7 18 0	8 3 0	1 8¾	1 9¼	1 8⅛	1 8¾
Maize Meal	1 : 13	86·4	8 12 6	9 0 0	9 2 6	8 10 0	2 0	2 1	2 1¼	1 11⅝
Maize Gluten Feed	1 : 3·3	121·6	8 5 0	—	—	—	1 4¼	—	—	—
Maize Germ Meal	1 : 8·4	99·2	8 2 6	8 10 0	—	8 10 0	1 7¾	1 8½	—	1 8½
English Feeding Barley	1 : 7·8	83·0	9 16 0	—	8 16 0	—	2 4¼	—	2 1½	—
English Oats	1 : 7·9	75·4	11 13 0	11 2 0	11 3 0	12 6 0	3 1	2 11¼	2 11½	3 3¼
Argentine Oats	1 : 7·9	75·4	11 12 0	10 14 0	11 5 0	—	3 1	2 10	2 11¾	—
Malt Culms	1 : 3·6	69·9	5 15 0	5 17 6	5 0 0	6 0 0	1 7¾	1 8¼	1 5⅛	1 8½
Brewers' Grains (dried)	1 : 3·4	84·5	7 0 0	—	6 10 0	6 17 6	1 8	—	1 6½	1 7½
Brewers' Grains (wet)	1 : 3·4	21·1	1 7 0	—	1 0 0	—	1 3¼	—	0 11⅜	—
Egyptian Rice Meal	1 : 10·3	78·7	—	7 2 6	6 12 6	—	—	1 9¾	1 8¼	—
Burmese Rice Meal	1 : 10·3	78·7	7 5 0	7 2 6	—	7 0 0	1 10	1 9¾	—	1 9¼
Wheat Middlings	1 : 5·3	93·4	6 10 0	6 12 6	7 5 0	—	1 4¾	1 5	1 6⅝	—
Wheat Sharps	1 : 5·3	86·3	6 7 6	6 12 6	7 10 0	7 7 6	1 5¾	1 6½	1 8⅞	1 8½
Wheat Bran	1 : 5·3	77·5	6 5 0	6 12 6	7 5 0	7 0 0	1 7¼	1 8½	1 10½	1 9¾
Wheat Bran (broad)	1 : 4·7	79·9	7 5 0	7 5 0	8 5 0	7 7 6	1 9¾	1 9¾	2 0¾	1 10

Soya Bean Cake.—Nutritive value, 1 : 1·1. Cost per food unit, 1*s.* 4½*d.*

The soya bean and its products are highly esteemed in the East for both man and beast. Owing to their comparatively recent introduction to this country, their practical value is not fully known. The cake is rich in protein, but possesses *distinctly* laxative, not to say scouring, properties. It should, therefore, be fed with great discretion, and it is suggested that it should never exceed one-fourth of the concentrated ration. At present prices it is a very cheap foodstuff, and should form an efficient substitute for part of the linseed cake in a ration. It can be mixed without danger with maize gluten feeds and a combination of bean and rice meal. It is usually fed in combination with common cotton cake. Further information is given in Special Leaflet No. 8.

Decorticated Cotton Cake.—Nutritive value, 1 : 1·3. Price per food unit. 1*s.* 6*d.*

This is the cheapest of the cakes in common use, probably because its use was abused when it was first introduced. It is a valuable feeding stuff, but should be fed with discretion, and should never exceed one-half the concentrated part of the ration. It goes well with maize (2 decorticated cotton cake, 4 maize), barley meal (2 decorticated cotton cake, 4 barley meal), maize germ meal, and a mixture of rice meal and bean meal (1 decorticated cotton cake, 1 bean meal, 2 rice meal).

Linseed Cake.—Nutritive ratio, 1 : 2. Price per food unit. 1*s.* 9½*d.*

This is held to be the most wholesome of all the cakes, and is especially esteemed for finishing fattening cattle. It may be mixed with anything so long as the mixture used does not lead to scouring. It is generally used in conjunction with cotton cake, bean meal, or a mixture of cotton cake and bean meal.

Common Cotton Cake.—Nutritive ratio, 1 : 2. Price per food unit, 1*s.* 11½*d.*

Both Egyptian and Bombay cotton cakes are in common use, being often mixed with more laxative concentrated foods owing to the binding properties they are known to possess. The Bombay cotton cake is apt to contain a lot of fibre, and is, therefore, dangerous for calves and lambs. Generally speaking, cotton cake is a better food for mature animals than for young growing stock. At present prices per ton Egyptian is cheaper than Bombay for feeding purposes.

Coconut Cake.—Nutritive ratio, 1 : 3·8. Price per food unit, 1*s.* 5½*d*

This cake is of comparatively recent introduction into this country. Per food unit it is a comparatively cheap food, and is esteemed on the Continent for dairy feeding, and may be fed in quantities up to 3 to 4 lb. a day, being damped before use. At present prices it might be used as a substitute for more expensive foods in the concentrated rations for dairy cows, and should certainly be given further trial for feeding for meat production. Further information is given in Special Leaflets Nos. 8 and 20.

Palm-nut Kernel Cake.—Nutritive ratio, 1 : 4. Price per food unit, 1*s.* 7*d.*

This food is dearer per unit on some markets than coconut cake. It is very similar to coconut cake, and may be substituted for it.

English Beans.—Nutritive ratio, 1 : 2·6. Price per food unit, 1*s.* 11*d.*

Beans are much cheaper per food unit than the cereal grains, and may be fed to advantage in conjunction with any laxative concentrated food. Beans should be used with discretion as they are very binding With linseed cake they form a very popular finishing ration.

English Peas.—Nutritive ratio, 1 : 3·2. Price per food unit, 2*s.* 7*d.*

Peas may be used for all purposes for which beans are fed, and have similar feeding properties. At the present ruling prices, peas are dear per food unit, and on this account should not be fed if beans are available.

Calcutta Peas.—Nutritive ratio, 1 : 2·3. Price per food unit, 3*s.*

These peas differ from English peas chiefly in having a higher protein content. Compared with English peas, they are dearer per unit, and their use is inadvisable in the present state of the market.

Maize.—Nutritive ratio, 1 : 11. Price per food unit, 1*s.* 9½*d.*

Maize, crushed or in the form of meal, is useful for all kinds of stock when fed in conjunction with concentrated cakes. At present prices it is dear, costing as much per food unit as linseed cake. Having a wide nutritive ratio it is valuable for giving mixed with concentrated cakes. Allowing for the cost of crushing, the meal is as cheap per food unit as the whole maize.

Maize Gluten Feed.—Nutritive ratio, 1 : 3·3. Price per food unit, 1*s.* 4½*d.*

This food, a by-product of maize, though having a different nutritive ratio, is very cheap per food unit, and (although there is still much to learn as to its feeding value in this country) it should prove a useful substitute for part of the concentrates,

since it is fairly rich in oil and protein. In the few cases in which it has been used extensively in England it has given very good results, being fed up to 5 lb. daily. It has been used in the United States with excellent results for dairy cattle and fattening stock, and is always used in conjunction with a light material such as wheat bran.

Maize Germ Meal.—Nutritive ratio, 1 : 8·4. Price per food unit, 1s. 8½d.

This, another by-product of maize, though differing in its nutritive ratio, is cheaper per unit, though containing more oil and protein, than maize meal. It should be worth a trial in many cases.

English Feeding Barley and Oats.—The use of these foods as feeding stuffs is strongly deprecated at the present time, as their price per unit is out of all proportion to their feeding value. (For substitutes for oats for farm horses, see Special Leaflet No. 19.)

Malt Culms.—Nutritive ratio, 1 : 3·6. Price per food unit, 1s. 7½d.

Malt culms form a brewery by-product, and are used extensively for stock in districts where they are readily obtained. They have a great reputation for feeding to fattening lambs, and at the present price per unit form a valuable and cheap food for general purposes.

Dried Brewers' Grains.—Nutritive ratio, 1 : 3·4. Price per food unit, 1s. 7½d.

Many experiments, at home and abroad, have established the value of this food for farm stock. It is a good feed for dairy cows, and is particularly useful for suckling ewes and growing lambs. It is quite wholesome and should be given a trial whenever it can be bought cheaply. At present prices it is a cheap food. (See also Special Leaflets Nos. 8 and 19.)

Wet Brewers' Grains.—Nutritive ratio, 1 : 3·4. Price per food unit, 1s. 1½d.

This food is the cheapest per food unit included in the table, and is largely used for feeding dairy cows. It is very palatable, and the low cost of the food is due to the fact that the difficulties of carriage restrict the consumption of the grains to certain localities, and to the fact that it varies very much in composition. Where available, wet grains should be used, but special care must be taken that they are delivered fresh, and that no more are given to the animals than can be consumed without causing scour. Over-feeding, especially after storage, leads to fermentation and consequent digestive disturbances. Where cleanliness and supervision of feeding

are exercised, this feeding stuff is very economical for the production of milk. It is largely used in Holland for fattening old cows for beef.

Rice Meal.—Nutritive ratio, 1 : 10·3. Price per food unit, 1s. 9½*d.*

Rice meal is very variable in quality, but where the analysis is good it is a cheap feeding stuff at present prices. It is particularly valuable for mixing with beans, with decorticated cotton cake, or with soy bean cake. A good mixture of English beans and rice meal can be made. It should not be used with common cotton cake. The best rice meal also forms the basis of many "calf meals," and mixed with bean meal and sharps forms a good food for fattening pigs. (Further information is given in Special Leaflet No. 16.)

"*Middlings.*"—Nutritive ratio, 1 : 5·3. Price per food unit, 1s. 5½*d.*

Middlings is much used for dairy stock, being a wholesome and palatable feeding-stuff. It is also much used for growing pigs and suckling sows. It is, however, not much used for fattening, and it would seem that present prices suggest a much more extensive use. More especially is this the case if substituted for barley meal in the production of pork and bacon. Middlings often gives very good results when fed to young animals being rapidly fattened off at an early age as beef or mutton.

Sharps.—Nutritive ratio, 1 : 5·3. Price per food unit, 1s. 7½*d.*

Sharps are so much like middlings that the food unit price may well be left to decide which of these two should be fed.

Bran.—Nutritive ratio, 1 : 5·3. Price per food unit, 1s. 10*d.*

Except that bran is said to "scour" young pigs, and that it may be made very laxative by feeding as a warm "mash," the same remarks apply as to sharps. At present prices the feeding of broad bran seems to be extravagant. (More detailed information concerning these by-products is given in Special Leaflet No. 8.)

The prices given per ton in the table on p. 55 represent for the most part the price *ex* mill, and do not allow for customs of credit, carriage, etc. In some cases the prices given include sacks. Since, however, these affect to a similar extent all the foodstuffs given, the usefulness of the table is not affected, and the relative comparative values given still hold, although the price per food unit is low in every case.

The figures given in the table are the prices ruling *ex* mill at the beginning of April, but the computation of feeding stuffs whose market value has risen since then can be easily

obtained by dividing the price per ton by the number of food units given in the table against the foodstuff under consideration.

From the table given below, showing the relative cost per food unit of 30 feeding stuffs now on the market, it appears that the cost of 1 food unit in different feeding stuffs varies from 1*s.* 1½*d.* to 3*s.* 1*d.* This amount of variation is quite exceptional, being caused by the great demand for certain feeding stuffs for military purposes, irregularity of transit, and other conditions arising from the state of war. Under these circumstances it is obvious that considerable economies may be brought about by replacing the dearer feeding stuffs by the cheaper ones. The following table gives the cost per food unit of all the feeding stuffs in the list on p. 55. The figure given in each case is the average cost at all the markets from which quotations were received. In very few cases is there any considerable variation in cost at the different markets.

	s.	*d.*	
Brewers' grains (wet)	1	1½	per food unit.
Maize gluten feed	1	4½	,, ,,
Soya bean cake	1	4½	,, ,,
Coconut cake	1	5½	,, ,,
Wheat middlings	1	5½	,, ,,
Decorticated cotton cake	1	6	,, ,,
Palm nut kernel cake	1	7	,, ,,
Brewers' grains (dry)	1	7½	,, ,,
Wheat sharps	1	7½	,, ,,
Malt culms	1	7½	,, ,,
Maize germ meal	1	8½	,, ,,
Maize, Argentine	1	9	,, ,,
Linseed cake, Indian	1	9	,, ,,
Rice meal, Egyptian	1	9	,, ,,
Wheat bran	1	9	,, ,,
Rice meal, *Burmese*	1	9½	,, ,,
Maize, American	1	10	,, ,,
Linseed cake, English	1	10	,, ,,
Wheat bran, broad	1	10½	,, ,,
Cotton cake, Egyptian	1	11	,, ,,
Beans, English	1	11	,, ,,
Cotton cake, Bombay	2	0	,, ,,
Maize meal	2	0½	,, ,,
Beans, Chinese	2	1½	,, ,,
Barley, English feeding	2	3	,, ,,
Peas, English dun	2	4½	,, ,,
Peas, English maple	2	9½	,, ,,
Oats, Argentine	2	11½	,, ,,
Peas, Calcutta white	3	0	,, ,,
Oats, English	3	1	,, ,,

It is satisfactory to note that feeding stuffs have decreased in price by about 1*d.* per food unit all round since the beginning of March.

The question of rations for different kinds of farm stock has been dealt with already in Leaflets No. 74 and No. 78. Special Leaflets Nos. 8, 16, and 19, also give suggestions for the modifications of rations to suit present conditions. Since they were issued, however, further changes in relative prices have occurred, to meet which the following notes have been

Farm Horses.—Since the issue of Special Leaflet No. 8 the price of oats has greatly increased, and very great economy can be attained by replacing oats by a mixture of feeding stuffs which have increased in price to a smaller extent than oats. For example, a mixture of 6 lb. of dried brewers' grains, 2 lb. of wheat sharps, 4 lb. of bran and 2 lb. of rice or maize meal, at present prices costs 11*d.* per stone, whilst a stone of oats costs 1*s.* 6*d.* The mixture is an excellent substitute for oats, and its use for horses getting a stone a day of corn results in a saving of about 7*d.* per head per day.

Fattening Cattle.—The present stall-feeding season is now approaching its end, and the few cattle still in the yards or boxes have probably reached the stage of finishing. In the earlier stages of fattening considerable economy might have been effected by substituting decorticated cotton cake, coconut cake, palm-nut cake or soya bean cake for linseed cake. For finishing, however, it will probably be wise to adopt a conservative policy, and adhere to a mixture of linseed cake and English bean meal, which may be relied on to produce a prime finish. Comparison of the prices per food unit shows that the saving which could be made by replacing such a tried and well-known finishing mixture by any of the less known cakes is not great enough to encourage graziers to take any risk.

Dairy Cows.—Where roots are short and grass is not ready brewers' grains at present prices will no doubt be much used for dairy cows if they can be bought fresh. In districts where they are available cow keepers are aware of the precautions necessary in using them. For dry food for dairy cows at present prices the following are amongst the cheapest suitable feeding stuffs:—Soya bean cake, decorticated cotton cake, coconut cake, palm-nut cake, dried grains, rice meal and bran. For use as an addition to usual quantities of home-grown fodders, the following rations may be suggested:

2 lb. Coconut cake. 2 „ Gluten feed. 3 „ Dried grains. 3 „ Bran.	or	2 lb. Palm-nut cake. 2 „ Gluten feed. 3 „ Bran. 3 „ Rice meal.

Sheep.—For sheep on roots and hay, or on grass, the following mixture used at the rate of from ½ to 1 lb. per head per day is as good value for money as can be obtained at the present time: 1 stone of decorticated cotton cake, 2 stones of dried grains, and 2 stones of bran.

Pigs.—A series of rations for pigs of all ages was given in Special Leaflet No. 16. The foods there recommended are all amongst the cheapest per food unit at the present time. No improvement on the rations there recommended can be suggested.

Collection and Sale of Drug Plants in England.

OWING to the shortage of drugs, largely due to the loss of supplies from Germany and Austria-Hungary, an opportunity has arisen for the collection of drug plants in England by those who are in a position to use their knowledge of field botany in this way. The Board think, therefore, that members of Natural History Societies and Field Botany Clubs throughout the country may be prepared to take part in this work, and they suggest that such members might usefully co-operate in the collection and sale of drug plants during the present year.

Leaflet No. 288, on "The Cultivation and Collection of Medicinal Plants in England," contains information as to various drug plants, and copies may be obtained gratis on application to the Board.

The more important species are Foxglove, Henbane, Thorn Apple and Belladonna, but many other species are useful, as indicated in the leaflet. It is most desirable that some definite arrangement should be made at the outset as to the plants to be collected, their sale and dispatch.*

The buyer would, no doubt, be willing to supply information as to any special requirements in respect of drying, preserving and packing, as well as to the ordinary technique of such operations, since in connection with certain species careful drying or immediate delivery may be indispensable.

The Board would emphasise the necessity for the careful identification of species, since in some instances very similar species may readily be confused.

It is highly desirable that collection should be conducted with discretion, so that a given species may not be unduly depleted in any locality, but that an ample stock may be left to preserve continuity.

It is as well to warn those who may decide to take part in the collection of drug plants against doing anything which could be regarded by possible buyers as useless or tending to waste their time.

In view of the fact that seeds of the various species of medicinal plants are not readily obtainable, the desirability might also be considered of collecting during the coming season a supply of seeds both for the collector's own use, and for distribution to others.

* A list of probable buyers of English-grown medicinal herbs, with one or other of whom collectors of drug plants may be able to come to some arrangement, may be obt[illegible] application to the Board.

The International Institute of Agriculture. Financial Position.

AT its first two meetings after the Christmas vacation, held in January and February, the Permanent Committee of the International Institute of Agriculture at Rome devoted most of its attention to a consideration of its financial position as indicated by the accounts for the past year and the budget for the coming year. At first sight the accounts for the calendar year 1914 appeared very satisfactory, as they showed on the ordinary work of the Institute a surplus of receipts over expenditure of £11,500, owing mainly to the fact that, in accordance with the decision of the General Assembly of 1913, the contributions of the adhering States had been raised to the maximum and amounted for the past year to £34,000 as compared with £20,520 in the previous year. To these contributions of the States has to be added the munificent grant of £12,000 made annually to the Institute by H.M. the King of Italy. On the other hand, the expenditure of the year, which amounted to a little over £36,000, only slightly exceeded the expenditure of the previous year; and on the assumption that all sums due to the Institute had been realised by the end of the year and all sums payable by it had been paid, there would have been a net surplus of £12,000 to be carried to the Reserve Fund, raising that Fund to £31,000. But the accounts also showed that a number of the adhering States were at the end of the year in arrear with their contributions to the amount of £14,780, and that the cash actually in hand at the end of the year was only £17,000. In the case of some of the States in arrear the delay in the payment of the contribution was no doubt due to financial embarrassment increased by the outbreak of war. But in most cases it appeared to have been chiefly due to delay in connection with obtaining sanction to the entry of the increased contribution in the budgets of the different States, and there was every probability that the greater portion of these arrears would be paid by the adhering States within the succeeding months. As a matter of fact, by the middle of March £6,720 had already been recovered, and the amount of arrears for past years had then been reduced to £8,060.

In accordance with a suggestion made by the British delegate, the accounts for the past year were audited by the Accounts Sub-Committee, on whose report the President of the First Commission signed a certificate to the effect that they had been found to be correct.

Notwithstanding the fairly satisfactory condition of the finances the Permanent Committee thought it desirable to continue to exercise the greatest economy compatible with the carrying on of its ordinary work, more especially by refraining from filling up the vacancies caused on the staff by the departure of a number of employees to serve under their respective flags.

In the budget for the calendar year 1915 the receipts are estimated at £47.000, on the supposition that all the adhering States will pay their contributions for the year before the end of December next. On the expenditure side the Permanent Committee, after carefully considering every reduction of expenditure possible without impeding the regular working of the Institute, sanctioned a total ordinary expenditure of £35,500, leaving a balance of £11,500, so that after adjustment of certain items of income and expenditure which are dealt with under special heads, it is estimated that there will be a surplus on the year's working of £10,000 to be added to the Reserve Fund, making it £41,200 at the end of the year, or more than equivalent to a year's expenditure. It is considered desirable that the Institute should have a large reserve of this character, partly in order to provide for possible delays in the payment of their contributions by the adhering States, and partly to allow for a gradual increase in expenditure in future years, owing to the rise of salaries of members of the staff in proportion to the length of their service and to a gradual expansion of the work undertaken by the Institute. It will be observed that, notwithstanding the recent large increase in income, the budget for the coming year anticipates practically the same total expenditure as during the two past years. At the same time, it is hoped that the Institute will be able to carry on its usual work with regularity and punctuality, though the staff is temporarily depleted owing to the war.

Proposed Conference on Ocean Freights.—At the February meeting the delegate for the United States presented a joint resolution passed by both Houses of Congress, asking that the General Assembly of the Institute should take into consideration the question of ocean freights on agricultural produce. The desire so expressed was to the effect that the General Assembly should instruct the International Institute of Agriculture to invite the adhering Governments to take part in an International Conference, with the object of giving greater stability to the p[illegible] of agricultural produce in the

whole world. It was suggested that this Conference should be composed of delegates nominated by the Governments which adhere to the Institute, and should consider the desirability of drawing up a convention which would establish an International Commerce Commission for Merchant Shipping and Ocean Freights, with consultative and deliberative powers, including the power of proffering advice on its own initiative; the Conference to be held in Rome in the fortnight preceding the following session of the General Assembly of the Institute. This important proposal was warmly supported by a number of delegates, and the Permanent Committee agreed to place it on the programme of the proceedings of the next General Assembly, and to consider later on whether it will be necessary to draw up a special report on the subject for the information of the Assembly.

Relations with Tropical Countries and Colonies.—At a previous meeting the Permanent Committee had decided to invite all countries and colonies which have not yet directly adhered to the Institute to give their adherence now and to send it the official statistics and reports regarding their agricultural produce, which are required to make the bulletins published monthly by the Institute more complete. The British delegate pointed out that the present was not an opportune time for asking countries and colonies to incur new expenditure by giving their adherence to the Institute and making contributions to its funds, and on his suggestion it was agreed to suspend that part of the previous decision which invited the Colonies to contribute to the Institute, and to confine the proposed circular letter to a description of the services which the Institute rendered, and is in a position to render, to tropical countries, and a request that they will furnish the Institute with the information required for its bulletins, of which a number of copies would be sent to them in exchange free of charge.

Grants in Aid of Agricultural Education and Research.

THE Board of Agriculture and Fisheries have issued new Regulations for grants in aid of Agricultural Education and Research in England and Wales for 1915-16.* The pamphlet contains the conditions on which all grants made by the Board for these purposes are awarded. Hitherto the conditions attached to different types of grants have been set out in various memoranda and circulars, and it is hoped that local education

* Cd. 7841. Messrs. Wyman and Sons, Ltd., Fetter Lane, E.C. Price 2*d*.

authorities and agricultural institutions will find the collection of these conditions into one volume handy for reference purposes.

Grants to Institutions.—The Regulations set out the conditions on which grants are made to approved institutions for the purpose, mainly, of providing instruction in agriculture, forestry, and horticulture of an advanced type, and also the conditions on which certain supplementary grants are made to selected colleges for the purpose of extending and developing the provision of technical advice for agriculturists and the investigation of local problems. The conditions laid down do not represent any material departure from existing practice, except in so far as the Board propose in future to consult their Advisory Committee on Agricultural Science in connection with grants to a university or college, and to invite members or co-opted members of the Committee to visit the institution for the purpose of advising the Board as to the value of the educational and scientific work in progress, the suitability and sufficiency of the buildings and equipment, and the amount of grant which may properly be made. The section of the Regulations which deals with agricultural research contains no new matter; it is based upon the Board's Research Scheme, which was printed in the *Journal* for October, 1911.

Grants to Local Education Authorities.—The section of the Regulations which sets out the conditions on which grants are to be awarded in aid of agricultural education provided by local education authorities of administrative counties (other than London) is entirely new. The three main objects of the new Regulations are (1) to aid on an increased scale the expenditure of those local authorities whose work has hitherto been aided by relatively small grants; (2) to provide a uniform system of awarding grants; and (3) to link up the higher and lower forms of agricultural education.

The present Regulations are intended to equalise the charge upon rate-payers in different counties by taking into account the whole of the work and expenditure of local authorities on agricultural education on a uniform basis. The new consolidated grant is based on the principle that the cost of agricultural education should be defrayed on a "partnership" basis as between tax-payer and rate-payer. The Board have taken the view that one-third of the local expenditure should be regarded as the minimum quota which should be contributed by the rate-pa[illegible] each county in return for the

direct benefits derived from the education provided. The second share in the expenditure comes from the State in the form of the residue grant. This grant to the county is available for all forms of higher education. It has been necessary, therefore, to estimate the proportion of the total grant received by the county which should, having regard to the needs of the agricultural population, be devoted to agricultural education. The third share in the expenditure will be derived from the Board's grant, which is intended to defray the balance of the expenditure not met from the two sources already mentioned. Payment of the maximum grant will, however, be subject to certain conditions, the most important of which is that the whole of the education provided is carried out (1) in an efficient and satisfactory manner and (2) at a reasonable cost.

Co-ordination of the Agricultural Education provided by Colléges and Counties.—This is a new feature of the Regulations, and is intended to secure a more definite connection between the two grades of agricultural education than has hitherto been the case. The two forms of agricultural education are interdependent, and as the tax-payer is called upon to support both higher and lower types of instruction, the rate-payer who benefits by the partnership here described is expected to contribute at least some share of the cost of higher agricultural education. Most local education authorities already make maintenance grants to institutions providing higher agricultural education. In future, all authorities claiming the additional grants referred to above will be required to aid the maintenance of the centre for higher education of the province. In fixing the minimum qualifying contribution the Board will take account of the character of the agricultural instruction provided and the net expenditure incurred by the agricultural education committees.

The object of this regulation is to secure that co-ordination of the various branches of agricultural education which is admitted to be desirable, but which has hitherto in some cases been lacking in actual practice. In the view of the Board the requirement of a definite contribution to the college will not only lead to a closer association of the county agricultural staff and the staff of the college, but will also provide the institutions in question with the means to extend their work in directions which are likely to prove of benefit to the locality.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

Radio-Active Substances as Fertilisers (*U.S. Dept. of Agric., Bull. No.* 149).—The properties of radio-elements and the influence of radio-active rays on plants are discussed. The experiments in England by Hedworth Foulkes on the Continent by Malpeaux, Berthault and Bretigniere (see this *Journal*, July, 1913, p. 324), and in Australia by Ewart, are reviewed and reference is made to the question of catalytic manures.

The conclusion is reached that "it seems incredible that radium or any of its products can have any economical application as a fertiliser in general farming; and still less credible that the so-called radio-active manure has any value, as far as its radio-activity is concerned, since the radium already present, on an average, in an acre-foot of soil, is about 100 times greater than is contained in the quantity of radio-active manure commonly recommended for application to an acre."

It is thought, however, that radio elements may prove of considerable value, justifying the expense involved in botanical research, and possibly also in greenhouse work.

Evidence is given to show that the action of uranium on plants is due to its chemical properties rather than to its property of being radio-active, and that the conflicting results obtained with radio-active manure from different sources is to be explained largely by the presence of uranium and of such non-radio-active constituents as soluble salts and free acids.

The Production and Manurial Value of Citric Soluble Phosphoric Acid and Potash (*U.S. Dept. of Agric., Bull. No.* 143).—A method of obtaining both potash and phosphoric acid in citric soluble form has been devised. It consists of mixing together phosphate rock and felspar with the addition of small quantities of the oxides of iron and manganese to promote fluidity or lower the melting point of the slag, the mass being then heated to about 1,500° C. for about 20 minutes. The resulting product is not only soluble in a 2 per cent. citric acid solution but is also fairly soluble in water saturated with carbon dioxide. Pot tests with typical soils showed that the mineral increased the growth of wheat plants but the beneficial effect derived from such applications was not, on the whole, as marked as it was when more soluble forms of phosphate and potash were used. The indications are, however, that the slag product has a distinct manurial value.

Salt as a Substitute for Potash (*Univ. Coll. of N. Wales, Bangor, Dept. of Agric.*).—A pamphlet describing the advisory work of the College contains a note on potash manures in which reference is made to the use of salt in the absence of potash manures. It is explained that all North Wales soils, except the lightest sands, contain abundance of potash of which, however, only a small proportion is in a form available for the use of plants; but that the application of salt to the soil would increase the proportion of potash available by acting on the unavailable

* A summary of all reports on agricultural experiments and investigations recently received is given each month. The Board are anxious to obtain for inclusion copies of reports on [illegible], whether carried out by agricultural colleges, [illegible] or private person.

supplies. The recommendation is therefore made that salt should be given to root crops—at the rate of 5 or 6 cwt. per acre for mangolds and 4 cwt. per acre for swedes and potatoes, the salt being broadcasted some weeks previous to sowing or planting the crop. Salt should not be mixed with superphosphate.

FIELD CROPS.

Varieties of Wheat (*E. Suffolk County Educ. Com., Rept. on Field Expts., Circ.* 15, 1915).—Tests with varieties of wheat were carried out at three centres in 1914, the soils being poor heavy land, good loam and heavy loam; the average yields were as follows:—Brooker's Double Standup 47 bush., Garton's Victor 46 bush., Swedish (Svalöf) Extra Squarehead II. 43½ bush., Squarehead's Master 39½ bush., and World's Wonder 39½ bush. The wheats took the following order as regards milling quality:—Squarehead's Master, Brooker's Double Standup, World's Wonder, Swedish Extra Squarehead II., and Victor.

Varieties of Wheat (*Northants C.C. First Ann. Rept. on Field Expts.*, 1914).—Little Joss and Squarehead's Master gave rather better results than Essex Conqueror, Browick Grey Chaff, and Cone on a cold clay soil.

Varieties of Wheat (*Jour. Dept. of Agric. and Tech. Instr. for Ireland*, Jan. 1915).—Both in 1913 and 1914 and both on a loam and gravelly soil Queen Wilhelmina gave larger yields than Red Fife in large scale experiments. In small scale experiments in 1914 at 17 centres the yields of grain per acre of four varieties were as follows:—White Standup, 25½ cwt.; White Queen, 24 cwt.; Red Chaff White, 23 cwt.; and Red Fife, 21½ cwt. These same varieties have given yields in the same order on the average of the previous six years.

Varieties of Winter Wheat (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—The experiments were carried out at four centres in 1914, the soils being of medium loam, heavy clay, chalky boulder clay and London clay respectively, the preceding crop at two centres being wheat. Sowing was carried out at the rate of 2 bushels per acre. The average yields per acre in bushels of 63 lb. were:—Little Joss 42·1, Victor 40·5, Squarehead's Master 39·4, Browick 39·3, Wilhelmina 36·2, Svalöf Extra Squarehead II. 36·2. Three varieties have been grown at the four centres for three years, the average results in bushels of 63 lb. per acre being:—Little Joss 41·7, Wilhelmina 39·7, Browick 37·6.

Varieties of Barley (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—The experiments were carried out in 1914 at four centres on strong loam, light loam on chalky subsoil, chalky boulder clay and light gravelly soils respectively, and the plots were sown at the rate of 3 bushels per acre. The average yields per acre of saleable grain in bushels of 56 lb. were:—Archer 45·1, Plumage Archer 39·7, Plumage 38·8, Chevalier 34·6, Maltster 34·3. In the three years during which the trials have so far been continued the average results have been:—Archer 48·5, Plumage-Archer 46·5, Plumage 43·5, Chevalier 41·1, Maltster 39·8. Plumage-Archer, Maltster and Plumage (in the order given) were much superior in standing power to the remaining two varieties.

Varieties of Barley (*Jour. Dept. of Agric. and Tech. Instr. for Ireland*, Jan., 1915).—Experiments in past years have shown that on heavy soils barleys of the broad-eared type succeed better than Archer, while Archer is relatively more prolific on light soil than broad-eared varieties. The results of trials in 1912, 1913 and 1914 with Beaven's "145" and Archer

indicate that there is no difference in yield between these varieties even on a light gravelly soil and under the very dry weather conditions experienced in 1914. Beaven's "145" proved considerably superior in yield in 1914 to Garton's Regenerated Standwell.

Small scale experiments showed the yield of Standwell to be inferior to Goldthorpe and the latter to be inferior to Archer.

Varieties of Oats (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—Sowing was carried out at the rate of 4 bush. per acre. The yields per acre (average of four centres) in bushels of 42 lb. were :—Leader 50·2, Golden Rain 48·6, Abundance 46·4, Beseler's Prolific 44·4, Victory 43·9, Potato Oat 35·9. Potato Oat produced most straw and Leader least.

Manuring of Barley (*Northants C.C. First Ann. Rept. on Field Expts.*, 1914).—At two centres, both on gravelly loams, a dressing of 3 cwt. superphosphate, 1 cwt. sulphate of ammonia and ¾ cwt. sulphate of potash raised the yield of grain by 11½ bush. and 9½ bush. per acre respectively over that of the unmanured plots ; when the potash was omitted from the dressing the increased yield, those of grain above on the unmanured plots, were 1½ bush. and 6¼ bush. per acre respectively.

FEEDING AND DAIRYING.

Feeding for Winter Milk (*E. Sussex Educ. Com. ; J. Noble Jack, F.R.S.E.*).—Of the 18 different rations tested the most satisfactory contained 1 lb. of albuminoids to 5 lb. starch equivalent, and the economy of production was affected adversely as this ratio was altered. The inferiority of other rations in comparison was due to an excess of starch ; the free use of apparently cheap cakes, rich in oil and soluble carbohydrates, but low in albuminoids, accounting for the greater cost of the less productive foods ; and the milk yield in every case was determined by the quantity of albuminoids present. For average herds in all stages of lactation 0·6 lb. digestible albuminoids and 3 lb. starch equivalent should, it is stated, be fed for every 10 lb. of milk given. The importance is emphasised of variety in compounding the ration and of analysis in purchasing foods.

Nutrition of Pigs (*Ohio Agric. Expt. Sta., Bull.* 271).—Maize, wheat middlings, linseed oil meal, soy beans, wheat bran and rice polish were shown to supply an insufficient amount of calcium to growing pigs, animals fed on these foods not maintaining normal growth of bone and therefore of size and strength. The importance of pasture, forage crops and dry roughage (especially of leguminous plants), as containing nutrients which grain foods lack, was demonstrated. Maize was found to be deficient in phosphorus and nitrogen as well as calcium. One part of salt to 256 parts of other food seemed to be more than sufficient for growing pigs.

Fish as Cattle Food (*Agric. Jour. of India*, October, 1914.)—Dried and ground sardines were fed at the rate of ½ lb. per head per day to six heifers for six months, six other heifers being used as controls. No ill effects followed from the addition of the fish to a mixed ration, and after a little time no trouble was experienced in getting the animals to eat it. So far as its fattening value was concerned fish did not compare favourably with ground nut. As a result it was not recommended for inland localities from a financial point of view though it was thought that a considerable saving might be effected by its use on the coast of India.

Wintering of Store Cattle (*U.S. Dept. of Agric., Bull. No.* 110).—The wintering of cattle by the use of concentrated foods in addition to pasture was found to be both economical and profitable for cattle which were to be fattened early in the summer; but the longer the summer grazing season the less economical and profitable was the previous winter feeding. Thus a difference, due to different winter feeding, of 109 lb. per steer at the beginning of the pasture season was reduced to 60 lb. by the time the animals were sold in July and August, and it was doubtful if there would have been any difference at all had all animals been pastured until October. (In this connection see also the Irish experiments summarised in this *Journal* for December, 1914, p. 842.)

HORTICULTURE.

Protection of Fruit from Frost (*Agric. Gazette of Canada*, January, 1915).—The heater used was the "Competition" heater, consisting of an ordinary pail of sheet iron with perforations round the top to allow of a draught of air and provided with a perforated rim fitting into the heater to assist the draught. Oil is used as fuel. One hundred heaters per acre have been found sufficient to raise the temperature of the surrounding air 8° F. on a very frosty night, and should raise the temperature by about 10° F. on a night having five or six degrees of frost. The method of distribution of the heaters depends upon the direction of the wind, the heaters being placed to windward of the area to be protected.

The initial expenditure per acre is given as £12 14*s*., *viz.*, 100 heaters at 1*s*. 3½*d* and a frost alarm thermometer at £6 5*s*. The cost of fuel and labour per acre for a night of 5 hours is given as £3 6*s*. 6*d*. The frost alarm thermometer is an arrangement for awakening the farmer when the temperature falls below a certain point.

In connection with the heater the use of a reflector for radiating the heat downwards was tried but without much success, as the effect was only felt immediately round the heater, and in the case of strawberries the plants round the heater were invariably burned.

WEEDS AND PLANT PESTS.

Fungicidal Action of Bordeaux Mixtures (*Jour. Agric. Sci., Vol.* VI., *Part* 2; *B. T. P. Barker, M.A., and C. T. Gimingham, F.I.C.*).—In order to throw more light upon the general action of copper fungicides, and, if possible, to obtain further evidence in support of conclusions previously reached,* experiments have been made to determine the action of copper compounds on plant cells other than those of fungi. The tests were made with broad bean, pea, and mustard seedlings, the root hairs of which provide types of cells comparable with the germ-tubes of fungus spores or the cells of actively growing hyphæ, and with apple leaves.

It was found that in some cases the root hairs were killed, deformed or discoloured as the result of the treatment, while in other instances they appeared to be uninjured. If the injurious action was due to the production of soluble copper by agencies other than the cell itself, the whole root-hair system should have been fairly equally affected instead of showing the extreme variations noted. It appeared, therefore, that living cells with readily permeable walls of the unchanged cellulose type

*See this *Journal* for December, 1911, p. 778.

or its equivalent are able to produce and absorb soluble copper from insoluble compounds.

The fate of the organism depends upon the relation between the amount of soluble copper produced and absorbed and the rate of growth of the organism. This is a significant point in connection with practical spraying, since it explains why there may be at times little check to the growth of a parasitic fungus after spraying, especially when the parasite has once gained a footing on the host plant.

Cells with walls of an impermeable character, such as those of apple leaves, possess no such power of solvent action upon insoluble copper compounds. In the case of apple leaves, only when there is injury to the cuticle sufficiently recent for no occlusion to have taken place, or when there is some radical alteration in its nature, is soluble copper produced.

Under changed conditions, cells with normally impermeable walls may become permeable and capable of action upon insoluble copper compounds. The difference in behaviour of apple foliage in summer and autumn would seem to be best explained in this way; and the change in the nature of the cell wall may be attributed to incipient death of the cells preparatory to leaf fall. This explanation accords with the fact that the hairs on the under surface of apple leaves (which are decadent cells) are affected by contact with the copper compound even in early summer when the epidermal cells (being full of life and vigour) remain unattacked.

It is evident, therefore, that the nature of the cell wall is the determinative factor in the direct action of the cell upon the Bordeaux compounds. It is stated that a comparison of the conclusions now reached with those derived from the previous experiments with cells of fungi shows that two distinct lines of work have led to identical results.

Potato Spraying with Bordeaux Paste and Bordeaux Mixture (*Woburn Exptl. Fruit Farm, 14th Report*).—The initial object of these experiments was to ascertain the proportion of Woburn Bordeaux paste equivalent in fungicidal action to ordinary Bordeaux mixture. The advantages claimed for the paste are simplicity of preparation of the spray fluid and the fact that a much smaller quantity of copper is required to produce a given result than in the case of Bordeaux mixture.

It was found that in a spray of moderate strength for ordinary potato disease 15 lb. or 16 lb. of paste to 100 gals. of water proved equivalent, as regards results, to Bordeaux mixture made with 8 lb. of copper sulphate. Trials were made with soda Bordeaux, but this preparation did not compare favourably with the paste or with ordinary Bordeaux mixture. Some experiments on soaking seed potatoes in copper sulphate solutions led only to a decreased yield. It appeared that with a fairly good crop, in years when disease is rife, one spraying with a fungicide of the strength indicated above may result in an increase in sound tubers of from 10 to 30 per cent.

The experiments seemed to indicate that while the percentage amount of disease present may actually be increased by spraying, the leaves are rendered more healthy and more free from the germs of disease generally, thus enabling the plant to bear a heavier crop. On the other hand, where the haulms are thus made more vigorous and succulent, they may afford a readier passage for the mycelium from such spores as have not been destroyed.

MACHINERY.

Milking Machines in Victoria (*Jour. Dept. of Agric., Victoria,* January, 1915).—Considerable use is made of milking machines in Victoria owing to the dearth of labour. To obtain the most satisfactory results the necessity of breaking in heifers to the machine and of the proper cleansing of the machines is insisted on. The writer does not think the yield is affected injuriously and considers the necessity of stripping by hand beneficial as massaging the udder and preventing atrophy. The cost of upkeep is placed at £1 per machine per annum.

From investigations carried out on a farm supplying infants with milk from healthy, tuberculin-tested cows the conclusions are drawn that (1) as regards bacterial contamination, milk obtained by machine is superior to hand-drawn milk even when the latter is obtained under the most approved conditions; and (2) that the machine does not interfere with the general health of the cow or of the udder provided that the apparatus is intelligently handled and that thorough attention is given to cleanliness and sterilisation.

NOTES ON CO-OPERATION AND SMALL HOLDINGS.

Progress of the Small Holdings Movement.*

THE total quantity of land acquired under the Small Holdings Act up to 31st December, 1914, was 198,288 acres, 139,478 acres having been purchased for £4,601,692 and 58,810 acres leased for rents of £74,180 a year. Of this land 178,911 acres had been actually let by county councils to 12,584 individual small holders and 506 acres sold to 50 small holders; and the councils of county boroughs have let 1,259 acres to 218 individual tenants. In addition 8,436 acres have been let to 63 co-operative small holdings associations, who have sub-let the land to 1,451 of their members, and 3,580 applicants have been provided with 47,500 acres by private landowners direct. The land which has been acquired by county councils, but which is not yet let in small holdings, amounts to 9,653 acres, which it is estimated will provide for 475 applicants, and the councils of county boroughs have about 310 acres not yet allotted which will probably provide for about another 50 applicants. It appears that the Act has resulted in the provision of small holdings for 18,486 applicants in seven years.

As regards the operations during 1914, these were considerably curtailed as a result of the war, the purchase of land being stopped and the rate of interest on loans granted by the Public Works Loan Commissioners for small holdings purposes being raised from 3½ to 4 per cent. In spite of the fact that the war prevented the purchase of any land during the last five months of 1914, the extent of the unsatisfied demand for small holdings at the end of the year was less than it had been at any time since the Act came into operation.

* Annual Report of Proceedings under the Small Holdings, &c., Acts for the year 1914. Part I.—Small Holdings. [Cd. 7851, price 3*d.*]

Co-operative Agricultural Credit in France in 1913.

IN continuation of the note on page 1113 of the Board's *Journal* for March, 1914, the following information is taken from the Report recently presented by the Minister for Agriculture on the working during 1913 of the co-operative credit societies in France, which are provided with a large proportion of their working capital by advances from State funds. At the end of 1913 there were 98 Central Banks (*Caisses regionales*), to which advances had been made by the State free of interest, the total amount at their disposal up to that date being £3,756,170.

The Central Banks had, at the end of 1913, advanced to local societies formed for the production and sale of agricultural produce, sums amounting to £527,500, on which the rate of interest charged was generally 2 per cent. The local societies in question have a membership of 48,000. Long-term loans amounting to £469,000 had also been granted to 3,098 peasants to enable them to obtain and work small holdings.

As regards the local credit societies formed for the purpose of making short-term loans to their members, the Report states that at the end of 1913 these societies numbered 4,533 with 236,860 members, an average of 52 members per society. They had a paid-up capital of £597,390, and during the year they made new loans to members amounting to £3,861,000, and recovered loans previously made to the amount of £3,509,000, the amount out on loan at the end of the year being £2,982,600. Their reserve funds at the end of the year amounted to £115,000.

NAMES AND ROUTES OF THE KING'S PREMIUM STALLIONS.

PARTICULARS of the Routes of the Stallions to which King's Premiums and Super-Premiums were awarded at the Show held at the Royal Agricultural Hall, Islington, London, N., on March 2nd and 3rd, 1915, together with the names and addresses of the owners of the Stallions, and of the members of the Stallion Committees which have been appointed to supervise the service arrangements, are given below. The Routes are subject to some alteration by arrangement between the owners and the Stallion Committees.

The District Classes for England and Wales are as follows:—

District Class.	Counties.	Number of King's Premiums.
I.	DURHAM NORTHUMBERLAND YORK, N. RIDING	Four King's Premiums.
II.	CUMBERLAND LANCASTER WESTMORLAND	Three King's Premiums.
III	YORK, E. RIDING YORK, W. RIDING	Six King's Premiums.

District Class.	Counties.	Number of King's Premiums.
IV.	LINCOLN, Parts of HOLLAND " " KESTEVEN " " LINDSEY NOTTS	Two King's Premiums.
V.	DERBY .. .. .. STAFFORD	Two King's Premiums.
VI.	CHESTER .. .. .. HEREFORD .. .. .. SALOP	Three King's Premiums.
VII.	ANGLESEY .. .. .. BRECKNOCK .. .. .. CARDIGAN .. .. .. CARMARTHEN .. .. .. CARNARVON .. .. .. DENBIGH .. .. .. FLINT .. .. GLAMORGAN .. .. .. MERIONETH .. .. .. MONMOUTH .. .. .. MONTGOMERY .. .. .. PEMBROKE .. .. .. RADNOR	Five King's Premiums.
VIII.	GLOUCESTER .. .. .. OXFORD .. .. .. WARWICK .. .. .. WORCESTER	Four King's Premiums.
IX.	BEDFORD .. .. .. HUNTS.. .. .. .. LEICESTER .. .. .. NORTHAMPTON .. .. RUTLAND .. .. .. SOKE OF PETERBORO' ..	Three King's Premiums.
X.	CAMBS .. .. .. ISLE OF ELY .. .. NORFOLK .. .. .. SUFFOLK	Two King's Premiums.
XI.	BUCKS .. .. .. ESSEX .. .. .. HERTS .. .. .. MIDDLESEX	Three King's Premiums.
XII.	KENT .. .. SURREY .. .. .. SUSSEX, EAST .. .. " WEST	Three King's Premiums.
XIII.	BERKS .. .. .. HANTS .. .. .. ISLE OF WIGHT	Three King's Premiums.
XIV.	DORSET .. .. .. SOMERSET .. .. .. WILTS	Four King's Premiums.
XV.	CORNWALL .. .. .. DEVON	Three King's Premiums.

District Class.	Stallion and Owner.	Counties in which travelling.	Route.	Stallion Committee.
I.	**Sandow.** The Compton Stud, Sandley, Gillingham, Dorset.	York (North Riding).	Headquarters: Langton Hall. Travels Thirsk, Pickhill, Bedale, Northallerton, Great Smeaton, Croft, and Richmond.	Mr. J. F. Baker-Baker, East Hall, Middleton Tyas, Yorkshire. Mr. T. Clark, Winton House, Northallerton. Mr. E. H. Courage, The Hall, Kirkby Fleetham, Bedale.
	Fitz Richard. Dr. A. O. Haslewood, Fairfield Stud, Buxton.	Northumberland	Headquarters: Alnwick. Travels Howick, Doxford, Chatton, Doddington, Lowick, Ford, Cornhill, Wooler, and Alnham.	Mr. B. Clayhills, Estates Office, Callaley, Whittingham, Northumberland. Mr. A. Fawcus, Louth Charlton Farm, Alnwick. Mr. J. Patten, The Park Farm, Alnwick. Mr. G. G. Rea, Middleton, Wooler, Northumberland.
	Maître Corbeau. Capt. T. L. Wickham-Boynton, and Mr. H. A. Cholmondeley, Burton Agnes Hall, Driffield.	York (North Riding).	Headquarters: Pickering. Travels Malton, Gilling, Helmsley, Kirby Moorside, and Snainton.	Mr. A. Pearson, Helmsley. Mr. J. Peters, Duncombe Park Estate Office, Helmsley.
	Jovial. The Lord Middleton, Birdsall, Malton.	York (North Riding).	Headquarters: Birdsall. Travels Malton, Pickering, Normanby, Salton, Slingsby, Hovingham, Terrington and Sheriff Hutton.	Capt. Clive Behrens, Swinton Grange, Malton. The Hon. T. Willoughby, Hildenley Home Farm, Malton. Mr. E. Parsons, Birdsall, Malton.

	Elector. Mr. A. McMahon, Corbally House, Ballylinan, Athy, Ireland.	Cumberland . .	Headquarters:—Carlisle . . Travels Cockermouth, Aspatria, Penrith, Longtown, and Brampton.	Mr. G. M. Bell, Land Agent, 1, Lonsdale Street, Carlisle. Mr. R. Edwin James, Manor House, Oughterside, Carlisle. Mr. W. R. Mounsey, 20, King Street, Penrith.
II.	**Tates.** Mr. R. Rimmer, M.R.C.V.S., 52, Stramongate, Kendal.	Westmorland	Headquarters:—Kendal . . Travels Appleby, Askham, Shap, Windermere, Kirkby Lonsdale, and Milnthorpe.	Mr. G. G. Robinson, Underley Farm, Kirkby Lonsdale. Mr. J. Wilson, Victoria Road, Penrith.
	Soft Answer. Mr. S. Mumford, Stud Farm, Moreton Morrell, Warwick.	Lancashire . .	Headquarters:—Cark . . . . Travels Lindale, Flockburgh, Barrow-in-Furness, Roose, Dalton, Ulverston, Carnforth, and Lancaster.	Mr. E. Bohane, Derby House, Preston. Mr. G. Dickinson, Cark Mills, Cark-in-Cartmel, Lancashire. Dr. E. S. Jackson, Robin Hill, Carnforth.
III.	***† Birk Cliff.** Capt. T. L. Wickham Boynton, and Mr. H. A. Cholmondeley, Burton Agnes Hall, Driffield.	York (East Riding).	Headquarters:—Burton Agnes Travels Beeford, Brandesburton, Beverley, Etton, and Driffield.	Mr. F. Reynard, Sunderlandwick, Driffield. Capt. J. Ridley, M.R.C.V.S., Beverley. Mr. G. Whiting, Estate Office, Burton Agnes, Driffield.
	*** Bachelor's Lodge.** Capt. T. L. Wickham-Boynton, and Mr. H. A. Cholmondeley, Burton Agnes Hall, Driffield.	York (East Riding).	Headquarters:—Burton Agnes Travels Swine, Humbleton, Nutt Hill, and Hedon.	Mr. F. Reynard, Sunderlandwick, Driffield. Mr. T. Robinson, Nutt Hill, nr. Hedon, Hull. Mr. G. Whiting, Estate Office, Burton Agnes, Driffield.

* Indicates the award of a Super-Premium.

† Indicates the award of the King's Champion Challenge Cup.

District Class.	Stallion and Owner.	Counties in which travelling.	Route.	Stallion Committee.
III. cont.	**Berrill.** Capt. T. L. Wickham-Boynton, and Mr. H. A. Cholmondeley, Burton Agnes Hall, Driffield.	York (East Riding)	Headquarters :—Burton Agnes. Travels Bridlington, Filey, Hunmanby, Weaverthorpe, Sledmere, and Killham.	Mr. R. Dixon, Dunnington Manor, Seaton, Hull. Mr. H. Holtby, Killham, Driffield. Mr. G. Whiting, Estate Office, Burton Agnes, Driffield.
	Forcett. Mr. J. Lett, Rillington, York.	York (East Riding).	Headquarters :—Rillington .. Travels Heslerton, Sherburn, Ganton, Foxholes, and Seamer	Mr. F. Reynard, Sunderlandwick, Driffield. Hon. T. Willoughby, Hildenley Home Farm, Malton. Mr. H. Wrigley, Ganton, Scarborough.
	Merry Fox. Capt. A. E. Clerk, c/o The Manager, Burton Agnes Stud, Driffield	York (West Riding).	Headquarters :—Chestnut Grove, Boston Spa. Travels Wetherby, Harrogate, Knaresborough, Ripon, Boroughbridge, and Tadcaster.	Mr. B. Day, The Rookery, Chapel Allerton, Leeds. Mr. B. North, 31, Market Place, Ripon. Mr. T. Robinson, The Laurels, Wetherby
	Crathorne. The Lord Middleton, Birdsall, Malton.	York (East Riding)	Headquarters :—Birdsall .. Travels Bossall, Stamford Bridge, Escrick, Market Weighton, and Pocklington.	Mr. C. N. Thompson, Red House, Escrick, York. The Hon. T. Willoughby, Hildenley Home Farm, Malton. Mr. E. Parsons, Birdsall, Malton.
IV.	**Wisemac.** Messrs. C. J. C. Hill and H. Drage, Glentworth Hall, Lincoln.	Lincoln (Lindsey)	Headquarters :—Glentworth. Travels Torksey, Lincoln, Brigg, and Caistor.	Mr. F. A. Holmes, M.R.C.V.S., Hemswell, Lincoln. Mr. Clifford Nicholson, Horkstow Manor, Barton-on-Humber, Hull. Mr. H. C. Tong, Office of the County Council, Mint Street, Lincoln.

IV. *cont.*	**Indian Runner.** Lt.-Col. R. L. Birkin, D.S.O., Edale House, The Park, Nottingham.	Nottingham ..	Headquarters :—Nottingham .. Travels East Leake, Clipstone, Cropwell Butler, Bingham, Flawborough, Newark, Fledborough, Tuxford, Ollerton, and Southwell.	Mr. T. Ellerby, Fledborough, Newark. Mr. F. Hardy, Staunton Hall, Nottingham. Mr. O. Quibell, Shalem Lodge, Newark. Mr. F. O. Thurman, Welldale, East Leake, Loughborough. Mr. H. W. T. Patterson, The Repository, Parliament Street, Nottingham.
V.	**St. Fagans.** Messrs. J. F. Rees and W. V. Howell Thomas, 22, Lammas Street, Carmarthen.	Stafford ..	Headquarters :—Madeley .. Travels Trentham, Newcastle, Longton, Stone, Lichfield, Penkridge, Stafford, Eccleshall, and Whitmore.	Mr. R. Carless, M.R.C.V.S., Stafford. Mr. J. Keen, Orgreave Gorse, Lichfield. Mr. R. S. Wilkinson, Swinchurch, Newcastle, Staffs. Mr. H. J. C. Winterton, Lichfield. Mr. E. Woodcock, M.R.C.V.S., Eccleshall, Stafford.
	King of the Wavelets. Dr. A. O. Haslewood, (Lessee), Fairfield Stud, Buxton.	Derby ..	Headquarters :—Buxton .. Travels Bakewell, Ashbourne, Uttoxeter, Sudbury, and Derby.	Mr. T. H. L. Duckworth, M.R.C.V.S., Ashbourne. Messrs. Hampson Bros., 3, The Quadrant, Buxton. Major F. W. Peacock, Vernons Oak, Somersall Herbert, Derby.
VI.	*** Neyland.** Major H. Heywood-Lonsdale, Shavington Grange, Market Drayton.	Salop	Headquarters :—Market Drayton Travels High Ercall, Shrewsbury, Oswestry, Ellesmere and Whitchurch.	Mr. R. Hughes, F.R.C.V.S., Oswestry. Mr. A. Mackenzie, F.R.C.V.S., Market Drayton. Mr. T. Whitfield, 12, Talbot Chambers, Shrewsbury. Mr. H. W. Fell, Shavington Grange, Market Drayton.

* Indicates the award of a Super-Premium.

District Class.	Stallion and Owner.	Counties in which travelling.	Route.	Stallion Committee.
VI. *ct.*	**Bacton Lad.** Mr. F. W. Barling, M.R.C.V.S., Bartestree Court, Hereford.	Hereford ..	Headquarters:—Hereford .. Travels Ledbury, Ross, Leominster, and Bromyard.	Mr. J. Bird, Livers Ocle, Hereford. Mr. E. H. Landon, Bullingham, Hereford. Capt. T. R. Symonds, Mynde Park, Hereford.
	Rays Cross. Mr. L. Cookson, Foxleigh, Wem, Shrewsbury	Chester ..	Headquarters: Tarporley .. Travels Bunbury, Nantwich, Crewe, Sandbach, Middlewich, Minshull Vernon, Wettenhall, Northwich, Chester, and Tarvin.	The Rev. Canon J. R. Armitstead, The Vicarage, Sandbach. Mr. E. C. Griffiths, Broken Cross, Northwich. Sir Gilbert Greenall, Bart., C.V.O., Walton Hall, Warrington. Mr. J. W. Macfie, Rowton Hall, Chester. Mr. G. Norris Midwood, The Grange, North Rode, Congleton. Mr. C. E. Parton, Haughton Hall Farm, Tarporley. Mr. D. B. Poole, Marbury Hall, Whitchurch.
VII.	* **Bachelor's Charm.** Lieut.-Colonel David Davies, M.P., M.F.H., "Broneirion," Llandinam, Montgomery.	Glamorgan ..	Headquarters:—Cowbridge .. Travels Wenvoe, St. Fagan's, Llantwit Major, Caerphilly and Abercynon.	Col. W. Forrest, D.S.O., Plymouth Estate Office, St. Fagan's, Cardiff. Mr. Iltyd Williams, Castleton, St. Athan, Cardiff. Mr. E. T. Lloyd, West House, Llantwit-Major, Cardiff.
	Sysonby. Messrs. J. F. Rees and W. V. Howell Thomas, 22, Lammas Street, Carmarthen.	Carmarthen ..	Headquarters:—Carmarthen .. Travels Nantcaredig, Llanarthney, Kidwelly, St. Clears, Whitland, Llanboidy, and Mydrim.	Mr. R. H. Harries, The Croft, St. Clears, Carmarthenshire. Mr. E. Jones, Manoravon, Llandilo, Carmarthenshire. Mr. D. H. Thomas, Starling Park, Carmarthen.

VII. cont.	**Just Cause.** Mr. J. Griffiths, Jameston Court, Manorbier, Pembs.	Pembroke ..	Headquarters :—Haverfordwest. Travels Boncath, Narberth, and Pembroke.	Mr. J. Gibbon, Vaynor, Narberth, Pembs. Mr. G. D. Llewellyn, Stephens Green, Milton, Pembroke. Mr. T. G. Phelps, Cresselly, Begelly, Pembs.
	Sanglamore. Messrs. J. F. Rees and W. V. Howell Thomas, 22, Lammas Street, Carmarthen.	Cardigan and Pembroke.	Headquarters :—Cardigan .. Travels Newcastle Emlyn, Fishguard, Letterston, and Haverfordwest.	Col. H. W. H. Brenchley, Glaneirw, Cardigan. Mr. G. B. Bowen, Llwyngwair, Newport, Pembs. Mr. R. B. Pretejohn, Heathfield, Letterston, Pembs.
	Pedlar Brand. Lieut.-Col. David Davies, M.P., M.F.H., "Broneirion," Llandinam, Mont.	Montgomery ..	Travels Manaton, Llanfair, Llanfyllin, Llansantffraid, Guilsfield, Pool Quay, Montgomery, and Berriew.	Mr. T. Green, Bank, Pool Quay, Welshpool. Mr. R. Morgan, Snowfield, Kerry, Mont. Mr. E. R. Owen, Nag's Head, Garthmyl, Mont. Mr. E. C. Morgan, Crown Chambers, Newtown.
VIII	***†‡ *Himan.*** The Compton Stud, Sandley, Gillingham, Dorset.	Gloucester ..	Headquarters :—Fairford .. Travels Cirencester, Cheltenham, Kingham, Northleach, and Tewkesbury.	Mr. P. Barnett, Cirencester. Mr. H. Dent-Brocklehurst, Sudeley Castle, Winchcombe. Mr. E. T. Prichard, Donnington Manor, Moreton-in-Marsh, Glos.
	*** Darigal.** The Compton Stud, Sandley, Gillingham, Dorset.	Gloucester ..	Headquarters :—Gloucester .. Travels Stroud, Tetbury, Chipping Sodbury, and Berkeley Road.	Major the Hon. L. Byng, Avening, Stroud. Mr. J. Pearce Ellis, Maisemore Court, Gloucester. Col. F. Henry, Elmestree, Tetbury. Mr. Aubrey Miller, Badminton, Glos.

* Indicates the award of a Super-Premium. † Indicates the award of Reserve for King's Champion Challenge Cup.
‡ This stallion died before serving any mares, and the Board accepted "John Lambton" as substitute.

District Class.	Stallion and Owner.	Counties in which travelling.	Route.	Stallion Committee.
VIII. cont.	*** Newmarket.** Lord Willoughby de Broke, Compton Verney, Warwick.	Warwick ..	Headquarters.—Kineton .. Travels Wellesbourne, Hampton Lucy, Stratford-on-Avon, Oxhill, Fenny Compton, and Radway.	Lord Willoughby de Broke, Compton Verney, Warwick. Mr. C. Kendal, Mount Pleasant, Walton, Warwick. Mr. J. Lea, Charlecote, Warwick. Mr. J. Wilkes, Tredington, Shipston-on-Stour.
	*** Puro Caster.** Lord Willoughby de Broke, Compton Verney, Warwick.	Worcester ..	Headquarters: Compton Verney. Travels Worcester, Droitwich, Kidderminster, Bromsgrove, and Redditch.	Major J. Baldwin, Groveley Park, Coston-Hackett, Birmingham. Mr. R. Cottrill, Sandal Lodge, Droitwich. Mr. A. Jones, Ombersley, Droitwich.
IX.	*** Chanteur.** Mr. J. Drage, Chapel Brampton, Northampton.	Northampton	Headquarters. Chapel Brampton. Travels Northampton, Wellingborough, Kettering, and Market Harborough.	Mr. J. Brown, Earls Barton House, Northampton. Mr. E. Messinger, Chapel Brampton, Northampton. Mr. H. R. Roe, Cranoe, Market Harborough.
	Lord Harry. The Earl of Lonsdale, Barley Thorpe, Oakham.	Rutland and Leicester.	Headquarters.—Oakham .. Travels North Luffenham, Uppingham, Melton Mowbray, and Loughborough.	Mr. H. S. Black, Frisby-on-Wreake, Leicester. Mr. J. Northen, Thorpe-by-Water, Uppingham. Mr. G. Underwood, Barley Thorpe, Oakham. Mr. D. Ward, Bescaby House, Melton Mowbray.

IX. *cont.*	**Chevalier.** Mr. D. Fraser, Tickford Park, Newport Pagnell.	Northampton ..	Headquarters :—Cotherstone Paddocks, Althorpe Park. Travels Harleston, Blisworth, Towcester, Brackley, Daventry, and West Haddon.	Mr. W. Murland, Badby House, Daventry. Mr. W. George, Gayton, Blisworth, Northants. Mr. J. G. Lawrence, Newnham, Daventry. Capt. F. D. Alexander, Chapel Brampton, Northampton.
X.	**Faithful Don.** Mr. Washington Charters, Horringer Manor, Bury St. Edmunds.	Suffolk ..	Headquarters :—Nowton .. Travels Bury St. Edmunds, Haverhill, and Stowmarket.	Mr. P. Brown, Rushbrooke, Bury St. Edmunds. Mr. S. Jaggard, The Queech, Pakenham, Bury St. Edmunds. Mr. H. Westrop, Long Melford.
	The Tailor. Mr. R. S. Howes (Lessee), The "Kennels," East Dereham, Norfolk.	Suffolk	Travels Ipswich, Woodbridge, Needham Market, Hadleigh, Bildeston, and Saxmundham.	Mr. J. G. Howells, St. Edmund's Road, Ipswich. Mr. J. Keeble, Brantham Hall, Manningtree, Essex. Mr. F. Stearn, Old Newton, Stowmarket.
XI.	**Captain Jack.** Mr. A. S. Bowlby, Gilston Park, Harlow.	Essex	Headquarters :—Gilston Park. Travels Bishop's Stortford, Dunmow, Braintree, Witham, Chelmsford, Ongar, and Harlow.	Mr. T. Christy, Roxwell, Chelmsford. Mr. J. Hughes, Gilston Park, Harlow. Mr. A. Waters, Coopersale Lodge, Epping. Mr. J. Bishop Young, F.R.C.V.S., Braintree.
	Ulpian. Mr. D. Fraser, Tickford Park, Newport Pagnell.	Buckingham ..	Headquarters :—Newport Pagnell. Travels Cosgrove, Hanslope, Stony Stratford, Buckingham, and Fenny Stratford.	Mr. F. W. Coales, Lathbury, Newport Pagnell. Mr. M. Grimes, Tickford Park Stud, Newport Pagnell. Mr. C. D. Pennant, Lillingstone Dayrell, Buckingham.

* Indicates the award of a Super-Premium.

District Class.	Stallion and Owner.	Counties in which travelling.	Route	Stallion Committee.
XI. *cont.*	**King Frederick.** Mr. H. J. King, Poles, Ware	Hertford ..	Headquarters: Poles, Ware .. Travels Stevenage, Hitchin, Codicote, Hatfield, Northaw, Broxbourne, Hoddesdon, and Hertford.	Lieut-Col. B. J. Gripper, The Drill Hall, Hertford. Capt. W. P. Jeffcock, West Common, Harpenden, Herts. Mr. J. C. McCowan, Hatfield.
XII.	**Stortford.** Capt. H. Faudel Phillips, Mapleton Stud, Eden Bridge.	Kent	Headquarters: Eden Bridge .. Travels Tonbridge, Paddock Wood, Maidstone, Kemsing, and Sevenoaks.	Mr. J. P. Hervey, Faulkners, Hadlow, Kent. Mr. F. P. Hirons, Linton Park, Maidstone. Mr. G. B. Winch, Boughton Place, Maidstone. Mr. W. G. Lambarde, Bradbourne Hall, Sevenoaks.
	Rockaway. Mr. C. Kelway-Bamber, "Priestlands Stud," Martyrs, Crawley.	Surrey and West Sussex.	Headquarters: Crawley .. Travels East Grinstead, Horsham, Guildford, Leatherhead, Epsom, and Reigate.	Mr. J. H. Driver, Melrose, Horsell, Woking. Mr. G. C. G. Leveson-Gower, Titsey Place, Limpsfield, Surrey. Capt. A. Smith, Roffey, Horsham. Mr. H. C. L. Steere, Jayes Park, Ockley, Dorking.
	Terra-cotta. Mr. C. Kelway-Bamber, "Priestlands Stud," Martyrs, Crawley.	East Sussex ..	Headquarters: Lewes .. Travels Hassocks, Hayward's Heath, East Grinstead, Uckfield, Heathfield, Battle, and Polegate.	Mr. Watkin James, Fir Grove, Burgess Hill, Sussex. Mr. J. E. Muggeridge, New Place, Framfield, Uckfield. Mr. H. T. Simmons, Wychnour, Battle, Sussex. Mr. T. Kirby Stapley, M.F.H., The Kennels, Catsfield, Battle, Sussex.

XIII.	**Cog.** The Compton Stud, Sandley, Gillingham, Dorset.	Berks ..	Headquarters :—Shrivenham .. Travels Faringdon, Challow, Goosey, Kingston Bagpuize, Abingdon, Steventon, and Buscot.	Mr. W. Crosland, Estate Office, Buscot Park. Mr. L. Paine, Fernham House, Faringdon. Col. G. C. Ricardo, Donnington, Newbury.
	General Stossel. Mr. S. Mumford, Stud Farm, Moreton Morrell, Warwick.	Berks ..	Headquarters :—Barkham .. Travels Twyford, Maidenhead, Windsor, Ascot, Bracknell, Wokingham, Strathfieldsaye, Hartley Row, Odiham, and Yateley.	Mr. A. D. Bruce, Estate Office, Elvetham, Odiham, Winchfield. Mr. R. H. Gosling, M.F.H., Hawthorn Hill, Bracknell. Mr. St. George Littledale, Wick Hill House, Bracknell. Mr. G. P. Male, Reading. Mr. E. M. Sturges, Barkham Square, Wokingham.
	Thorndyke. Mr. H. Arnold, Crews Hill Paddocks, Enfield, Middlesex.	Hants ..	Headquarters :—Bishop's Waltham. Travels Tichborne, Alton, Basingstoke, Whitchurch, and Hursley Park.	Mr. R. Austin, Bishop's Waltham, Hants. Mr. J. F. Complin, Holybourne, Alton. Mr. F. Coryton, The Manor House, Greatham, Liss, Hants. Mr. T. A. Edney-Hayter, The Mount, Whitchurch, Hants. Sir Richard Rycroft, Bart., Dummer House, Basingstoke.
XIV.	*** Gilgandra.** The Compton Stud, Sandley, Gillingham, Dorset.	Somerset ..	Headquarters :—Sandley .. Travels Frome and Shepton Mallet.	Mr. L. B. Beauchamp, Norton Hall, Bath. Mr. A. C. Clarke, Red Lion Hotel, Shepton Mallet. Major A. L. Langman, C.M.G., North Cadbury, Bath.
	*** Bagotstown.** The Compton Stud, Sandley, Gillingham, Dorset.	Wilts	Headquarters :—Swindon .. Travels Wootton Bassett, Malmesbury, Cricklade, and Highworth.	Mr. H. Baker, Chedglow Manor, Crudwell, Malmesbury. Mr. T. Hooper-Deacon, Swindon. Mr. H. C. Sutton, Hold Croft, Blunsdon, Highworth, Swindon.

* Indicates the award of a Super-Premium.

District Class.	Stallion and Owner.	Counties in which travelling.	Route.	Stallion Committee.
XIV. *cont.*	*** Renown.** The Compton Stud, Sandley, Gillingham, Dorset.	Wilts	Headquarters, Chippenham.. Travels Melksham, Westbury, Devizes, and Calne.	Mr. F. Doble, Berwick Bassett, Swindon. Mr. W. Preston, M.F.H., Seend, Melksham. Mr. V. T. Taylor, Steinbrook House, Chippenham.
	Thistledown. The Compton Stud, Sandley, Gillingham, Dorset.	Dorset ..	Headquarters Dorchester .. Travels Bridport, Beaminster, Maiden Newton, Cerne Abbas, Puddletown, and Bere Regis.	Col. Brough, 56, High West Street, Dorchester. Mr. R. G. Cave, Almer, Blandford. Mr. F. Pope, Great Toller, Dorchester.
XV.	**Golden Grebe.** Messrs. W. & H. Whitley, Primley Farm, Paignton.	Cornwall ..	Travels Fotnes, Liskeard, St. Austell, Truro, St. Columb, Wadebridge, and Bodmin.	Mr. C. Burleigh, Sportsman's Arms, Menheniot Station, Liskeard. Mr. Coulter Hancock, 12, Princes Street, Truro. Mr. H. G. P. Hoblyn, Colquite, Washaway, Cornwall. Mr. Brooking Trant, Trethawle, Liskeard. Mr. T. Yeo, St. Leonards, Bodmin.
	Marzio. Mr. M. J. Taylor, Ermington, Ivybridge, Devon.	Devon ..	Headquarters Ermington .. Travels Plympton, Ivybridge, Brent, Totnes, Newton Abbot, Dawlish, and Exeter.	Mr. P. G. Bond, M.R.C.V.S., 105, Union Street, Plymouth. Mr. A. Hingston, Bridgetown, Totnes. Mr. R. Johnson Marr, Kingsbridge.
	Otterton. Mr. Jerry Rohan, Loughcarrig, Ballinacurra, Midleton, Co. Cork, Ireland.	Devon ..	Travels Honiton, Exeter, Crediton, Tiverton, and Cullompton.	Mr. Ian H. Amory, Knightshayes Court, Tiverton. Mr. R. J. Brown, Boro' House, Axmouth, Axminster. Mr. W. B. Nelder, F.R.C.V.S., 33, Paul Street, Exeter.

* Indicates the award of a Super-Premium.

OFFICIAL NOTICES AND CIRCULARS.

Issue of Special Leaflets.

THE purpose of the Board's Special Leaflets was explained in the note in the *Journal* for September, 1914, p. 566, and lists of those issued have been given from time to time. The following further Special Leaflets have been prepared :—

Special Leaflet No. 24.—Seed Testing.
,, ,, 25.—Technical Advice for Farmers.
,, ,, 26.—Suggestions to Allotment Holders for General Cropping during the Spring and Summer Months.
,, ,, 28.—Suggestions for the Cultivation of Catch Crops and Home Grown Feeding Stuffs.
,, ,, 29.—Flax Growing for Fibre.

Destruction of Rats.

IN view of enquiries received as to methods of dealing with the depredations of rats on farm premises, the Board of Agriculture and Fisheries are reissuing a Leaflet on the subject containing suggestions for concerted action for the extermination of these pests. Copies of the Leaflet (No. 24.—The Destruction of Rats) may be obtained free on application to the Secretary of the Board, 4, Whitehall Place, London, S.W.

Report of the Animals Division of the Board.

THE Report of the Board for the year 1914 of proceedings under the Diseases of Animals Acts, the Markets and Fairs (Weighing of Cattle) Acts, &c., has been recently issued [Cd. 7852, price 5½*d*.]. It contains *inter alia* an account of the work accomplished during 1914 with regard to foot-and-mouth disease, tuberculosis, swine-fever, sheep scab, anthrax, glanders, and parasitic mange, and gives details of the modifications which were made by the Board in their usual procedure in various instances as a consequence of the outbreak of war. A number of useful statistical tables are included at the end of the Report.

MISCELLANEOUS NOTES.

Agricultural Labourers and Enlistment in H.M. Forces.

RETURNS obtained by the Board of Trade during February from over 30,00 farmers throughout England and Wales show that the number of male persons in regular employment at the end of January, 1915, was 12·4 per cent. less than in January, 1914. As 15·6 per cent. of the persons employed a year ago have joined the naval or military forces, it is evident that farmers have been able to fill the places of one in five of those who have joined. These men have been replaced from the ranks of casuals or

from among those who get fairly continuous work in the summer, but are unemployed, or do other than agricultural work, in the winter:

The table below gives for each Labour Exchange district the percentage of those employed a year ago who had joined the forces by the end of January:—

Percentage of Agricultural Employees who have joined the forces in various Labour Exchange Districts in England and Wales. (Number employed in January, 1914 = 100.)

	Per cent.		Per cent.
South Eastern ..	15·7	Yorkshire	17·3
South Western ..	18·0	Northern	9·6
West Midlands ..	14·0	North Western ..	14·2
East Midlands ..	12·7	Wales	14·9
		Average ..	15·6

The fact that the above figures include a certain number who are employed as civilians by the Government for other than military purposes, partly explains the very high figure for the South Western Division, since considerable numbers have been attracted in Wiltshire to the various military camps on Salisbury Plain. The elimination of this element would not, however, reduce the gross figure probably by more than 1 per cent.

In the West Midlands, the great prosperity of industry, and the demand for labour in the metal trades, are responsible for keeping the enlistment percentage low in industrial employments, while the same consideration is responsible for the even lower figure in Yorkshire; but agriculturists in both these districts have enlisted in considerable numbers. In the northern counties, the low percentage of recruiting in agriculture is explainable by the fact that in some of these counties May hirings are the rule rather than winter hirings, and several correspondents state that farmers are expecting a very considerable increase of enlistment when the men have served out their year.

As regards casual labour, the returns show that the number of casuals at work, though slightly below the figures for a year ago, are not abnormal for the time of year. In view, however, of the shortage of regular hands, farmers complain that the supply is less than the demand, and in particular it has been difficult to get a sufficient number of men for threshing. Casual employment, however, in the winter months is always small; the numbers amounting to about one-quarter of the number required in the summer months.

At the time of the enquiry (end of January) the lack of labour in agriculture could hardly be called acute, since the work to be done in winter is less than at any other season, and in a normal year even the regular hands are not always fully employed. Generally speaking, therefore, farmers were managing to carry on with their reduced staff, except that where labour of special skill was required it was almost impossible to fill the places of men who had joined the forces. This may in cases seriously disturb the whole farm. Thus, the most urgent need at the moment was for milkers, horsemen (who have been recruited in especially large numbers for the new armies), and men competent to work threshing machines. The immediate scarcity of labourers was being most acutely felt in Surrey, Sussex, and Wiltshire, in all of which the demand by the military for camp building, etc., has drawn men from agriculture; in Staffordshire and Warwickshire where men have been attracted townwards by the very great prosperity of the Birmingham district; in

Westmorland and Yorkshire, where there has been rather heavy enlistment from the agricultural classes, and where labour was already getting scarce before the war; and in South Wales, where there is a general complaint of agricultural labourers being attracted to the mines.

The returns give some indication of the summer needs of agriculture. The number of men in continuous employment appears to be normally about 4 per cent. larger in the summer than in the winter. To bring the labour supply, therefore, up to normal dimensions would require not merely the making good of the existing contraction of 12·4 per cent., but also the addition of a further 4 per cent. of regular hands. There would also be required something like a four-fold increase in the present number of casual labourers. In other words, it may be estimated that unless the farms are to work shorthanded, or means can be found to economise labour, some 80,000 additional permanent male labourers and 90,000 casuals will be required in the summer (June). A certain proportion of the latter will, no doubt, be available as usual, but in view of the present state of the labour market, farmers are doubtful of their ability to find all this additional male labour. Steps are therefore being taken to meet the difficulties in various ways.

In many cases unessential work, such as clipping hedges, etc., is being left undone.

In Gloucestershire and Herefordshire, farmers are laying down land to grass, while in several counties it is reported that milch cows have been sold owing to the shortage of qualified milkers. The high price of feeding-stuffs is, however, a co-ordinate consideration in the matter. In Essex, it is stated, corn is being grown instead of roots, as the latter require much labour, while the final operations of the former can be carried out by machinery.

In Norfolk, it is said that farmers are pressing further than ever the use of machinery in various ways, while in Kent it is stated that hops are being grubbed up, partly because they require so much labour in the later stages, and partly because it is thought that the beer tax will curtail the demand for hops. In some cases it is actually stated that land is going out of cultivation altogether for want of labour.

In certain counties the lack of temporary casual labour for threshing has meant that the permanent hands have been recently put on to do this work, so that some agricultural operations of the farm have fallen behindhand. This lack of casual labour foreshadows serious difficulties in the hopping and fruit-growing counties in the spring and early summer.

In this connection it may be observed that in the counties which rely on the annual migration of Irish labour, and in particular in Cheshire and Lancashire, farmers are apprehensive that the ordinary influx will not occur this year in as large a volume as usual. The number of Irish migratory labourers has been rapidly dwindling in recent years, and this year here will be many alternative openings for labourers who normally come to this country, and even a shortage in Ireland itself, for it is estimated that over 30,000 men have been called up or have enlisted from those employed in agriculture in Ireland. The more prosperous Ireland becomes the less ready are the labourers of Connaught to spend the summer working in the English counties; but the high rate of wages for temporary labour that is likely to prevail may be sufficient to attract migration in as large a volume as usual.

AGRICULTURAL RETURNS OF THE UNITED KINGDOM,* 1914.

Acreage and Production of Crops.

Crops.	Acreage. 1914.	Acreage. 1913	Produce.** 1914.	Produce.** 1913.	Yield per acre. 1914.	Yield per acre. 1913.	Average yield per acre of 10 years 1904–13.
	Acres.						
Total Area (excluding water)	70,457,278		—		—	—	—
Total Acreage of Crops and Grass † ..	46,042,051	46,018,448	—		—	—	—
Arable Land	19,320,823	19,338,767	—		—		—
Permanent Grass—			Tons.	Tons.	Cwt.	Cwt.	Cwt
For Hay	6,489,885	6,798,877	8,162,555	10,164,048	25·25	29·90	28·85
Not for Hay	20,832,243	20,480,804		—	—	—	—
Total.. .	27,322,128	27,279,681		—	—	—	—
			Quarters.	Quarters.	Bshls.	Bshls.	Bshls.
Wheat	1,904,932	1,790,376	7,804,611	7,087,050	32·77	31·67	31·88
Barley or Bere ..	1,871,169	1,930,052	8,065,678	8,204,060	34·48	34·01	34·03
Oats	3,877,964	3,961,429	20,063,537	20,660,279	42·63	41·72	41·94
Rye	60,783	63,449	—	—	—	—	—
Beans‡	301,375	275,511	1,120,078	950,309	30·72	28·60	29·85
Peas‡	169,804	161,608	374,038	423,255	23·02	26·41	26·60
			Tons.	Tons.	Tons.	Tons.	Tons.
Potatoes	1,197,008	1,173,418	7,476,458	7,604,804	6·25	6·48	5·63
Turnips and Swedes ..	1,752,574	1,762,130	24,105,755	25,313,815	13·83	14·40	14·66
Mangold	515,864	500,209	9,522,921	9,270,120	18·50	18·54	19·42
Cabbage Kohl-rabi and Rape	191,343	188,410	—	—	—	—	—
Vetches or Tares§ ..	137,447	114,399	—	—	—	—	—
			Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
Hops	36,661	35,676	507,258	255,641	13·84	7·17	8·94
Small Fruit¶	100,710	99,726	—	—	—	—	—
Clover and Rotation Grasses—			Tons.	Tons.			
For Hay	2,902,902	3,025,345	4,210,924	5,231,040	29·01	34·58	32·49
Not for Hay ..	3,659,688	3,574,636	—		—	—	—
Total.. ..	6,562,590	6,599,981	—	—	—	—	—
Other Crops	286,625	282,923	—	—	—	—	—
Bare Fallow	347,965	396,140	—	—	—	—	—

Live Stock.

—	1914.	1913.
	No.	No.
Horses used for Agricultural Purposes (including Mares kept for breeding) ..	1,320,466	1,333,155
Unbroken Horses including Stallions: One year and above ..	350,362	358,504
Unbroken Horses including Stallions: Under one year ..	171,729	174,086
Total Horses ..	1,842,557	1,865,745
Cows and Heifers in Milk or in Calf ..	4,576,852	4,300,611
Other Cattle: Two years and above ..	2,326,584	2,479,753
Other Cattle: One year and under two ..	2,587,853	2,571,767
Other Cattle: Under one year ..	2,653,274	2,544,348
Total Cattle ..	12,144,563	11,896,479
Ewes kept for breeding ..	11,221,604	11,025,059
Other Sheep: One year and above ..	5,037,911	5,349,430
Other Sheep: Under one year ..	11,626,580	11,177,647
Total Sheep ..	27,886,095	27,552,136
Sows kept for breeding ..	492,981	400,978
Other Pigs ..	3,446,906	2,893,237
Total Pigs ..	3,939,887	3,294,215

* Exclusive of the Isle of Man and Channel Islands where no produce statistics are collected.
** The figures of Produce for Ireland are subject to revision.
† Exclusive of Mountain and Heath Land used for grazing.
‡ Figures include acreage but not produce of areas picked or cut green, except in the case of Beans in Scotland, where the acreage picked or cut green is excluded.
§ Figures for Scotland include Beans, Mashlum, &c., for fodder.
¶ Figures for Ireland include Orchards.

Notes on Crop Prospects Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for March, 1915, gives figures which may be taken to represent the world's production of cereals in the harvest year 1914–15. The countries included are Germany, Austria, Hungary, Belgium, Bulgaria, Denmark, Spain, France, Great Britain and Ireland, Italy, Luxemburg, Norway, Netherlands, Rumania, Russia in Europe, Sweden, Switzerland, Canada, United States, India, Japan, Russia in Asia, Algeria, Egypt, Tunis, Argentina, Chile, Australia, and New Zealand.

Wheat.—The total production in the above-mentioned countries amounted to 460,900,000 qr. against 501,520,000 qr. in 1913–14, or a decrease of 8·1 per cent. The production, however, was greater by 0·7 per cent. than the average production of the five preceding years, and by 7·5 per cent. than the average of the 10 preceding years.

Rye.—The production in the above countries, excluding Great Britain, India, Japan, Algeria, Egypt, Tunis, Chile, Australia, and New Zealand, is placed at 203,159,000 qr. against 218,013,000 qr. in 1913–14, or a decrease of 6·8 per cent. It was also smaller by 0·4 per cent. than the average of the five preceding years, but greater than the average of the 10 preceding years by 5·5 per cent.

Barley.—For the same group of countries, with the exception of India, Chile, and Australia, the production is estimated at 168,293,000 qr. in 1914–15 against 193,168,000 qr. in the previous harvest year, or a reduction of 13 per cent. It was also smaller by 5 per cent. than the average of the 5 preceding years, but greater by 2·6 per cent. than the average of the 10 preceding years.

Oats.—For the same countries as aforementioned, omitting India, Egypt, Chile, and Australia, the total production is placed at 441,600,000 qr. against 490,330,000 qr. in 1913–14, or a diminution of 9·9 per cent. It was also smaller than the average of the five preceding years by 2·7 per cent, but greater than the average of the 10 preceding years by 6·2 per cent.

India.—The preliminary estimate of the wheat crop places the production at 48,986,000 qr. in 1914–15, against 39,315,000 qr. in 1913–14, or an increase of 24·6 per cent., while the area cultivated was also greater by 23 per cent.

Sowing of winter cereals.—The areas estimated to have been sown to cereals in 1914–15, compared with the areas sown during the corresponding period of 1913–14, expressed as percentages, are as follows:—*Wheat.*—Denmark, 103; Great Britain, 110; Italy, 105; Luxemburg, 107; Rumania, 92; Switzerland, 110; Canada, 109; United States, 111; Japan, 99. *Rye.*—Denmark, 93; Luxemburg, 106; Rumania, 76; Switzerland, 110; United States, 103. *Barley.*—Rumania, 71; Switzerland, 105; Japan, 102.

France.—The official report on the condition of the crops in France on 1st March is as follows:—Winter wheat 68 as compared with 71 in 1914, rye 72 against 73, winter barley 69 against 69, and winter oats 70 against 66 in 1914 (100 = very good, 80 = good, 60 = fairly good). (*London Grain, Seed and Oil Reporter*, 24th March.)

Russia.—The Department of Rural Economy and Household Statistics, on the basis of upwards of 7,000 communications from growers, have come to the following conclusion relative to the influence of the weather (to the 23rd February) on the condition of winter sowings in European Russia: Notwithstanding the fact that the winter set in generally late, and that up to the middle of December the winter plants, especially in the Black Soil region, remained with poor snow-

cover, they were, nevertheless, unharmed practically everywhere as the frosts at this period did not exceed 20 to 24 degrees Fah., and were not continuous. The rather keen frosts experienced later on in December did not harm the sowings, as these were now already under snow. Only the appearance of an ice crust, after the January thaw, gave cause for fear; however, trustworthy indications of the possibility of damage to the plants at this period of the winter are almost always absent. One factor which might bring about extensive damage to the sowings is the very wet state of the soil, as, in consequence of the swift melting of the snow at the time of strong and protracted thaws in January and February, the low-lying fields appeared to be inundated with water. Field mice also threatened damage in parts of New Russia and Caucasia, the vermin being numerous. (*Broomhall's Corn Trade News*, 18th March.)

Australia.—The latest official estimate of the wheat harvest in the six Australian States gives the yield at a little more than 29½ million bushels, as compared with 108 million bushels in 1913, and 96 million bushels in 1912. (*London Grain, Seed and Oil Reporter*, 11th March.)

South Africa.—According to information received at the office of H.M. Trade Commissioner for South Africa from the Commissioner of Customs and Excise at Pretoria, a good maize crop all over the Union is anticipated. In Natal it is expected that the crop will constitute a record for the past 20 years, and that there will be a surplus of 2,000,000 bags for export. In the Orange River Colony also a record is expected, some estimates placing it as high as 3,000,000 bags, three-fourths of which will be available for export. (*Board of Trade Journal*, 25th March.)

Agricultural Conditions in England and Wales on 1st April.

THE Crop Reporters of the Board, in reporting on agricultural conditions in England and Wales, state that the drier weather prevailing over most of the country during March, especially in the latter half of the month, has effected some improvement in agricultural conditions. Winter beans and oats are generally doing well.

Very variable progress has been made with spring sowing. In the south, good progress was made, especially on light land, during the latter half of the month, although the season is still in this respect a backward one, except perhaps in the extreme south-western counties. In the north, where the weather was more stormy, less progress had been made. In most districts the young crops are not yet showing, but where they are up they look quite well.

Potato planting was being pushed forward towards the end of the month in the fen districts of Lincoln, and Norfolk, and a beginning had been made in Lancashire and Cheshire, but it was checked by the frosts at the end of the month. Otherwise but little had been done, except with the earliest kinds.

Seeds are generally vigorous and satisfactory in the north and west, but in the south they are generally a much thinner plant, although healthy: in the midlands they are variable.

Ewes are generally in poor condition after the trying winter. The fall of lambs has generally been about average, but hardly more, and in the later northern flocks results are rather poor, a somewhat considerable mortality among ewes or lambs being reported from various localities in this part of England. In the south the health of the flocks is generally more satisfactory, and the strength of the lambs materially improved during the latter part of the month.

Particulars with regard to wheat and the supply of agricultural labour are given in the two following statements.

Condition of the Wheat Crop in England and Wales on 1st April.

ACCORDING to statements published in the Board's Monthly Agricultural Report for 1st April, 1915, early-sown wheat on that date was looking well on light land, but in many districts wheat on heavy land and also late-sown autumn wheat on light land was backward and had lost colour. The total area under wheat is about 10 per cent. greater than last year. The following are the particulars for the various districts:—

Northumberland, Durham, Cumberland, and Westmorland.—Where sown early on dry land autumn-sown wheat was generally satisfactory, but that sown late, or on heavy wet land, was weak, and of a bad colour. The area under wheat is probably about one-tenth greater than last year on the whole. Some spring wheat had been got in.

Lancashire and Cheshire.—Autumn-sown wheat, on the whole, looked fairly well, though backward in some districts; that late sown was weak and patchy, however, and a few crops, on land which has been waterlogged, will be ploughed up. There is about 10 per cent. more land under wheat than a year ago.

Yorkshire.—Autumn-sown wheat varied considerably, the early sown on dry land looked well, but on heavy land, or where late sown, the crop was thin and backward, and of a bad colour, and a few fields had been ploughed up. The area is probably rather more than 5 per cent. above that of 1914.

Shropshire and Stafford.—Winter wheat on the heavy lands was thin and backward, and frequently of a poor colour, though on drier soils its condition was about average. The area is about 10 per cent. greater than last season.

Derby, Nottingham, Leicester, and Rutland.—On the dry lands autumn-sown wheat was, on the whole, healthy. On the low-lying or heavy lands the plant looked starved. The area is about one-tenth greater than a year ago.

Lincoln and Norfolk.—In north Lincolnshire autumn-sown wheat was weak and backward, but elsewhere in the county the crops looked well, except on cold wet land, where it was of a bad colour. In Norfolk the crop was not so good, and, except for some of the early sown, it was generally thin and backward. The area is about one-tenth greater than last year.

Suffolk, Cambridge and Huntingdon.—The late-sown autumn wheat and that on heavy and low-lying land showed signs of damage from the wet and some had turned yellow. Wheat on light soils, particularly if early sown, was doing much better; the acreage is about 10 per cent. greater than last year.

Bedford, Northampton and Warwick.—On light land, autumn-sown wheat looked well, but on heavy soils it was backward and had lost colour. The area sown is from 5 to 10 per cent. greater than last year.

Buckingham, Oxford and Berkshire.—Autumn-sown wheat was looking fairly well except on heavy or flooded lands, where it was thin and backward, and occasionally yellow. The area is about 10 per cent. greater than last year.

Worcester, Hereford and Gloucester.—Early-sown autumn wheat generally looked promising and was of a good colour, but the late-sown on heavy lands was rather thin and backward. The area is about 10 per cent. above that of last season.

Cornwall, Devon and Somerset.—Early-sown autumn wheat was

generally healthy, but later sown and that on heavy land was backward. The area is about 10 per cent. above that of last season.

Dorset, Wiltshire and Hampshire.—The appearance of autumn-sown wheat was improved by the drier weather; the later-sown, though still somewhat backward, is improving. The area is about 10 per cent. greater than last year.

Surrey, Kent and Sussex.—Autumn-sown wheat was backward. There was a good healthy plant on the lighter land, but on heavy soils the crop was often thin and of a bad colour. On the whole, about one-eighth more land is under wheat than a year ago.

Essex, Hertford and Middlesex.—In Essex and parts of Hertfordshire a good deal of the autumn-sown wheat was yellow and backward, especially on heavy land or where sown late. The area is probably about 5 per cent. greater than last year.

North Wales.—Autumn-sown wheat was generally strong and healthy, but was checked by frosts towards the end of March; where sown late or on heavy land, however, the crop had lost colour. The area is probably greater by nearly a fifth than last year.

Mid-Wales.—Where sown late or on low-lying heavy land, autumn-sown wheat was weak and thin; that sown early on dry land, however, was a promising plant. The area is about one-eighth greater than that of last year.

South Wales.—Late-sown autumn wheat and that on heavy soils was backward and had in many instances turned yellow. The acreage is nearly 10 per cent. greater than last year.

Agricultural Labour in England and Wales during March.

ACCORDING to statements in the Board's Monthly Agricultural Report (1st March) the supply of labour was deficient practically everywhere, although wages showed a rising tendency, temporary hands being particularly difficult to obtain.

The following local summaries give further details regarding agricultural labour in the different districts of England and Wales:—

Northumberland, Durham, Cumberland and Westmorland.—The supply of labour was deficient throughout this division.

Lancashire and Cheshire.—In a few districts the supply of labour was sufficient for requirements during March, but generally there was a scarcity of workers, and sometimes the supply was very deficient.

Yorkshire.—There was a decided shortage in the supply of labour throughout the division, horsemen and milkers were very scarce, and fears were expressed lest temporary labour for potato planting should not be forthcoming.

Shropshire and Stafford.—Labour was everywhere very scarce, particularly for temporary work. Wages continued to rise.

Derby, Nottingham, Leicester and Rutland.—A general deficiency in the supply of labour was making itself felt. Notwithstanding the payment of higher wages, it was hardly possible to obtain sufficient labour.

Lincoln and Norfolk.—The supply of labour was short throughout the division, temporary labour was difficult to obtain, and a scarcity of horsemen was being seriously felt in parts of Lincolnshire.

Suffolk, Cambridge and Huntingdon.—Labour was short generally, but in Suffolk the shortage was not seriously felt as not very much

Bedford, Northampton and Warwick.—Labour was very short throughout the district and temporary help was very difficult to get. Wages increased generally.

Buckingham, Oxford and Berkshire.—The shortage of labour, especially skilled, continued throughout the district and hampered the progress of spring cultivation.

Worcester, Hereford and Gloucester.—Labour was very short in all districts, and some further increases of wages were reported.

Cornwall, Devon and Somerset.—A shortage in the supply of permanent and temporary labour was reported throughout the division, and, with the increase in farm work, the deficiency was being felt. Advances in wages were made generally.

Dorset, Wiltshire and Hampshire.—Labour was scarce, and the shortage was being increasingly felt owing to the favourable weather conditions. Temporary labour for potato planting was very difficult to obtain.

Surrey, Kent and Sussex.—In west Sussex and in west and mid-Kent, although there was a short supply of labour, the deficiency was not seriously felt. In most parts of Surrey, and in the east of Kent and east Sussex, the supply was, however, very short.

Essex, Hertford and Middlesex.—The supply of labour was short everywhere; temporary labour was very hard to get, in spite of higher wages.

North Wales.—In Anglesey the supply of labour was generally sufficient for requirements, although temporary labour was getting more difficult to obtain. Elsewhere the supply was, as a rule, deficient.

Mid-Wales.—The supply of labour was very short in Montgomery and parts of Radnor. In north Cardigan a scarcity of workers was being much felt, but in other parts of Cardigan and in Brecon there was a fairly satisfactory supply. Wages were raised by 1*s.* to 2*s.* a week in Radnor and Brecon.

South Wales.—There was a general shortage of labour in all but one or two districts, and in many instances wages were raised.

Prevalence of Animal Diseases on the Continent.

THE following statement shows that according to the information in the possession of the Board on 1st April, 1915, certain diseases of animals existed in the countries specified:—

Denmark *(month of February).*

Anthrax, Foot-and-Mouth Disease (181 outbreaks), Glanders and Farcy, Swine Erysipelas, Swine Fever.

France *(for the period February 21st—March 6th).*

Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox.

Holland *(month of February).*

Anthrax, Foot-and-Mouth Disease (88 outbreaks), Foot-rot, Swine Erysipelas.

Italy *(for the period March 8th—14th).*

Anthrax, Blackleg, Foot-and-Mouth Disease (232 outbreaks), Glanders and Farcy, Rabies, Sheep-pox, Sheep-scab, Swine Fever, Tuberculosis.

Norway *(month of February).*

Anthrax, Blackleg.

Rumania *(for the period December 29th—January 6th).*

Foot-and-Mouth Disease (122 animals), Glanders and Farcy, Rabies, Sheep-pox, Sheep-scab, Swine Fever.

***Russia** (month of November).*
Anthrax, Foot-and-Mouth Disease (48,863 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

***Spain** (month of December).*
Anthrax, Blackleg, Dourine, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

***Sweden** (month of February).*
Anthrax, Blackleg, Swine Erysipelas.

***Switzerland** (for the period March 15th—21st).*
Anthrax, Blackleg, Foot-and-Mouth Disease (83 "étables" entailing 1,192 animals, of which 11 "étables" were declared infected during the period), Swine Fever.

No further returns have been received in respect of the following countries:—Austria, Belgium, Bulgaria, Germany, Hungary, Montenegro, Serbia.

The Weather in England during March.

District.	Temperature. Daily Mean.	Temperature. Diff. from Average.	Rainfall. Amount.		Rainfall. Diff. from Average.	Rainfall. No. of Days with Rain.	Bright Sunshine. Daily Mean.	Bright Sunshine. Diff. from Average.
	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours.
Week ending Mar. 6th.								
England, N.E. ...	42·4	+3·7	0·35	9	0	5	2·7	—0·3
England, E.	43·7	+4·9	0·59	15	+ 6	5	3·1	0·0
Midland Counties ...	43·9	+5·1	0·47	12	+ 1	4	2·7	0·0
England, S.E.... ...	44·3	+4·3	0·41	10	— 2	4	2·8	—0·3
England, N.W. ...	42·9	+3·4	0·84	21	+ 7	6	1·4	—1·4
England, S.W. ...	44·2	+3·2	0.06	17	— 1	5	2·4	—0·8
English Channel ...	46·3	+2·5	0·26	7	— 8	4	3·5	—0·1
Week ending Mar. 13th:								
England, N.E. ...	42·1	+2·6	0·19	5	— 6	3	2·5	—0·9
England, E.	41·2	+1·6	0·14	4	— 5	3	1·8	—1·6
Midland Counties ...	41·2	+1·5	0·10	3	— 8	2	2·1	—1·0
England, S.E.... ...	41·8	+1·0	0·12	3	— 8	3	1·9	—1·5
England, N.W. ...	41·7	+1·6	0·16	4	—10	2	2·8	—0·2
England, S.W. ...	41·0	+0·1	0·13	3	—14	2	3·2	—0·2
English Channel ...	44·3	+0·1	0·17	4	—11	3	2·5	—1·7
Week ending Mar. 20th.								
England, N.E. ...	41·1	+0·4	0·60	15	+ 4	3	4·3	+0·3
England, E.	40·5	—0·4	0·28	7	— 1	2	2·2	—1·8
Midland Counties ...	40·9	—0·1	0·13	3	— 6	2	3·4	—0·1
England, S.E.... ...	41·7	—0·3	0.02	1	— 9	1	2·6	—1·2
England, N.W. ...	41·1	—0·1	0·31	8	— 5	4	3·2	—0·1
England S.W. ...	41·6	—0·9	0·02	1	—13	1	4·2	+0·3
English Channel ...	44·2	—0·9	0·00	0	—12	0	4·1	—0·7
Week ending Mar. 27th.								
England, N.E. ...	41·4	+0·1	0·39	10	+ 1	5	5·0	+0·7
England, E.	42·1	+0·3	0·55	14	+ 5	5	4·2	+0·1
Midland Counties ...	40·9	—0·9	0·46	12	+ 3	4	4·0	+0·1
England, S.E.... ...	42·6	—0·3	0·34	9	— 1	3	3·6	—0·6
England, N.W. ...	41·8	—0·1	0·31	8	— 5	3	5·3	+1·5
England, S.W. ...	42·7	[illegible]	0·48	12	— 3	3	4·0	—0·4
English Channel ...	[illegible]	[illegible]	0·37	9	— 3	4	3·1	—2·1

* 1 inch = [illegible]·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	MARCH.		THREE MONTHS ENDED MARCH.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	53	76	208	243
Animals attacked	53	81	228	261
Foot-and-Mouth Disease:—				
Outbreaks	—	6	—	11
Animals attacked	—	43	—	74
Glanders (including Farcy):—				
Outbreaks	—	7	7	26
Animals attacked	—	23	11	70
Sheep-Scab:—				
Outbreaks	27	18	134	134
Swine Fever:—				
Outbreaks	256	294	948	781
Swine Slaughtered as diseased or exposed to infection ...	1,131	2,763	3,973	7,278

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	MARCH.		THREE MONTHS ENDED MARCH.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	1	—	1	—
Animals attacked	1		1	—
Foot-and-Mouth Disease:—				
Outbreaks	—	50	—	52
Animals attacked	—	683	—	711
Glanders (including Farcy):—				
Outbreaks	—	—	—	—
Animals attacked	—	—	—	—
Parasitic Mange:—				
Outbreaks	3	4	13	29
Sheep-Scab:—				
Outbreaks	44	70	175	288
Swine Fever:—				
Outbreaks	26	27	65	61
Swine Slaughtered as diseased or exposed to infection ...	160	93	408	317

Unit Prices of Artificial Manures.

Statement of cost to the purchaser of 1 p cent. per ton of Nitrogen, Soluble and I soluble Phosphates, and Potash derived fro

	London.	King's Lynn.	Hull.	Newcastle
	s. d.	s. d.	s. d.	s. d.
Nitrogen from :				
Sulphate of Ammonia pure ... 95%	14 9	14 0	—	14 0
Sulphate of Ammonia pure ... 93%	—	—	14 2½	13 11
Calcium Cyanamide ...	12 11	—	—	11 11
Nitrate of Soda pure ... 95%	—	—	15 4	—
Nitrate of Soda pure ... 90%	16 6½	16 0	15 4	15 6
Nitrate of Lime ...	—	—	15 4	15 3½
Soluble Phosphates from :				
Superphosphate 35%	2 4	2 0	2 4	2 2½
,, 33%	2 4½	—	2 4½	2 2½
,, 30%	2 5½	2 2	2 6	2 3½
,, 26%	2 8½	2 4	2 8½	2 6
Dissolved Bones	3 7	3 6	3 4½	3 3½
Allowed for Nitrogen	*19 6*	*19 1½*	*18 7½*	*17 10½*
Allowed for Insol. Phos.	*1 9*	*1 8½*	*1 8*	*1 7*
Insoluble Phosphates (Citric Soluble) from :				
Basic Slag	1 10	—	—	—
Insoluble Phosphates from :				
Basic Slag	—	—	1 4	1 3½
Bone Meal	1 7	—	1 5	1 5
Allowed for Nitrogen	*17 9*	—	*15 11½*	*16 1½*
Steamed Bone Flour ..	1 6		1 5½	1 5
Allowed for Nitrogen	*16 10½*		*16 3½*	*16 4½*
Potash from :				
Kainit	—	—	—	—
Sulphate of Potash ...	—	—	—	—
Muriate of Potash ...	—	—	—	—
Potash Salts	—	—	—	—

NOTE.—These unit prices are based on the *probable* retail casl prices in bags f.o.r. for quantities of not less than 2 tons of the manure mentioned at the ports and places specified, but it should be borne i mind that market prices are fluctuating considerably at the presen time. The prices are published by the Board of Agriculture and Fisherie for use in comparing the commercial values of artificial manures. They may also be used as a guide to the probable price per ton of any of th manures mentioned if the unit prices of the constituents of th

various sources, at certain ports and Manufacturing Centres, for April, 1915.

	Silloth.	Liverpool.	Widnes.	Newport.	Bristol.	Plymouth.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
	—	—	14 6	13 10½	—	—
	14 2	14 8	14 8	—	14 3	15 2½
	—	11 9½	—		—	12 8
	15 8	14 6	14 8	-	15 2	14 10
	—	—	—	15 11	15 8	15 4
	—	—	—	—	15 10	—
	2 2½	2 2	2 1	2 5½	2 5½	2 5½
	2 3	2 2	2 1	2 6½	2 6½	2 6½
	2 3½	2 2½	2 1½	2 7½	2 7½	2 7½
	2 6	2 5	2 3½	2 10½	2 10½	2 10½
	3 4	3 6½	3 6	3 10½	3 11½	4 0½
	18 3	*19 5*	*19 3*	*21 1½*	*21 8½*	*22 1½*
	1 7½	*1 9*	*1 8½*	*1 11*	*1 11*	*1 11½*
	—	1 0½	—	—	1 11	—
	—	1 3½	—	—	—	—
	1 9	1 5½	1 0	1 4½	1 4½	1 6
	19 8½	*16 6*	*16 11*	*15 3*	*15 5½*	*17 0½*
	1 7	—	—	1 3½	1 5	1 7½
	17 8	-	—	*14 4½*	*16 1½*	*18 4*
	—	—	—	—	—	—
	—	—	—	—	—	—
	—	—	—	—	—	—
	—	—	—	—	—	—

manure are multiplied by the percentages of the constituents found in it, and due allowance is made for the difference between cash prices and credit prices, and for cost of carriage from the nearest centre to the place where it is delivered to the purchaser. If used in connection with the valuation of a compound manure regard must be had to the sources of the constituents, and a reasonable sum must be added for mixing, disintegrating and rebagging the ingredients, bags, and loss of weight.

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in March and February, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	March. First Quality.	March. Second Quality.	February. First Quality.	February. Second Quality.
FAT STOCK :—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle :—	s. d.	s. d.	s. d.	s. d.
Polled Scots	10 11	10 5	10 9	10 5
Herefords	10 10	9 10	10 8	9 10
Shorthorns	10 9	9 11	10 7	9 9
Devons	11 0	10 0	10 8	9 9
Welsh Runts	10 7	9 7	10 6	9 4
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	11	9¾	10	9¼
Sheep :—				
Downs	11½	10½	10½	9½
Longwools	11	9¾	10¼	9
Cheviots	12½	11¼	11	10
Blackfaced	11¼	10½	10¾	9¼
Welsh	11	10¼	10½	9½
Cross-breds	11½	10½	10½	9½
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs :—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	9 0	8 6	8 5	7 11
Porkers	9 4	8 10	8 10	8 4
LEAN STOCK :—	per head.	per head.	per head.	per head.
Milking Cows :—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	24 0	20 2	24 18	20 15
,, —Calvers ...	22 11	18 16	23 5	19 12
Other Breeds—In Milk ...	21 12	18 5	23 9	19 8
,, —Calvers ...	18 4	16 10	18 0	16 0
Calves for Rearing	2 13	2 2	2 15	2 3
Store Cattle :—				
Shorthorns—Yearlings ...	12 13	10 14	12 13	10 16
,, —Two-year-olds...	16 14	14 17	16 15	14 17
,, —Three-year-olds	20 7	18 1	20 15	18 0
Herefords —Two-year-olds...	19 8	17 11	19 17	17 12
Devons— ,,	17 0	15 16	17 2	15 4
Welsh Runts— ,,	16 15	15 9	17 10	15 5
Store Sheep :—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	54 11	47 1	49 9	44 5
Store Pigs :—				
8 to 12 weeks old	21 7	16 0	20 3	15 7
12 to 16 weeks old	37 10	27 10	35 5	26 4

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in March, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham.	Leeds.	Liverpool.	London.	Manchester.
		per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.
BEEF:—						
English	1st	72 6	72 6	—	74 6	72 6
	2nd	68 0	70 0	—	70 6	68 0
Cow and Bull	1st	65 6	67 6	66 0	65 6	65 0
	2nd	58 6	59 6	61 0	60 6	59 6
Irish: Port Killed	1st	—	—	71 6	73 0	70 0
	2nd	—		67 0	69 0	66 6
Argentine Frozen—						
Hind Quarters	1st	63 0	62 0	62 0	61 6	62 0
Fore ,, ...	1st	59 0	59 6	58 6	57 6	58 6
Argentine Chilled—						
Hind Quarters	1st	63 0	63 0	62 0	64 0	61 6
Fore ,, ...	1st	57 6	57 6	57 6	57 6	57 0
Australian Frozen—						
Hind Quarters	1st	60 0	60 6	60 6	61 6	60 6
Fore ,, ...	1st	57 6	59 6	58 0	58 0	58 6
VEAL:—						
British	1st	81 0	83 6	91 0	80 6	85 0
	2nd	72 6	75 0	81 0	71 0	80 6
Foreign...	1st	—	—	—	83 0	—
MUTTON:—						
Scotch	1st	88 0	—	95 0	91 0	96 0
	2nd	72 6	—	89 6	85 6	91 6
English...	1st	80 6	87 0	—	85 6	91 0
	2nd	74 0	82 0	—	80 6	85 6
Irish: Port Killed	1st	79 6	—	87 6	—	84 0
	2nd	—	—	77 0	—	79 6
Argentine Frozen	1st	54 6	54 6	53 0	54 0	53 0
Australian ,, ...	1st	52 0	52 0	51 6	52 6	51 6
New Zealand ,, ...	1st	54 0	58 6	—	57 6	—
LAMB:—						
British	1st	104 6	115 6	112 0	113 0	107 0
	2nd	97 0	—	102 6	103 0	100 6
New Zealand	1st	73 0	71 0	73 6	75 0	74 0
Australian	1st	67 0	66 6	66 0	67 6	66 0
Argentine	1st	66 6	67 6	66 6	67 6	65 6
PORK:—						
British	1st	70 0	73 0	75 0	81 0	75 6
	2nd	74 0	67 6	70 0	76 0	71 0
Foreign...	1st	—	—	—	78 0	—

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in March, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	BRISTOL.		LIVERPOOL.		LONDON.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
BUTTER:—	per 12 lb	per 12 lb	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb
British	17 0	16 0	—	—	16 3	15 3
	per cwt	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	—	—	—	—	—	—
" Factory	—	—	—	—	—	—
Danish...	—	—	145 0	143 0	143 0	139 6
French...	—	—	—	—	139 6	135 6
Russian	—	—		—	132 0	128 6
Australian	140 0	137 6	139 6	137 0	138 6	134 6
New Zealand	142 0	140 0	142 0	140 0	140 6	137 0
Argentine	139 6	137 0	138 0	136 0	136 6	133 0
CHEESE:—						
British—						
Cheddar	98 0	95 0	98 0	96 0	101 0	96 0
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	100 0	95 0	107 0	101 6
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	94 0	92 0	93 6	92 0	95 0	93 0
BACON:—						
Irish (Green)	85 0	80 0	84 6	79 0	86 0	82 0
Canadian (Green sides)	73 0	69 0	73 6	68 0	75 0	71 0
HAMS:—						
York (Dried or Smoked)	115 6	113 6	—	—	116 0	108 0
Irish (Dried or Smoked)	—	—	—	—	110 0	104 0
American (Green) (long cut)	66 0	62 0	64 6	61 6	66 0	62 6
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British...	11 10	10 5	—	—	13 9	12 11
Irish	12 9	12 3	12 10	11 11	13 5	12 6
Danish...	—			—	15 0	12 10
POTATOES:—	per ton	per ton.	per ton.	per ton.	per ton.	per ton.
Edward VII.	105 0	95 0	85 0	—	100 6	89 6
Langworthy	101 0	91 0	100 0	95 0	106 0	100 0
Up-to-Date	99 0	87 6	83 6	76 6	104 0	93 6
HAY:—						
Clover	...	—	103 6	82 0	105 0	95 6
Meadow				—	95 6	87 0

LIBRARY
TNAU, Coimbatore - 3
000003483

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	WHEAT.						BARLEY.						OATS.					
	1913.		1914.		1915.		1913.		1914.		1915.		1913.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Jan. 2...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
,, 9...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
,, 16...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
,, 23...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
,, 30...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
,, 13...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
,, 20...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
,, 27...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
,, 13...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
,, 20...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
,, 27...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3...	31	4	31	6	54	0	27	0	25	6	31	9	19	2	18	5	30	6
,, 10...	31	3	31	5			27	8	26	8			19	2	18	4		
,, 17...	31	6	31	7			26	11	25	4			18	10	18	4		
,, 24...	31	8	31	9			26	7	26	6			19	3	18	5		
May 1...	32	2	31	9			25	11	26	0			19	6	18	5		
,, 8...	32	6	32	2			25	9	25	6			19	6	18	9		
,, 15...	32	10	32	7			25	4	26	3			19	9	18	11		
,, 22...	32	10	33	0			25	3	25	10			19	11	19	0		
,, 29...	32	7	33	9			26	1	26	1			20	1	19	4		
June 5...	32	10	34	0			26	2	25	11			19	8	19	4		
,, 12...	32	8	34	1			24	7	24	11			20	2	19	8		
,, 19...	32	8	34	1			23	10	25	10			19	8	19	9		
,, 26...	32	8	34	3			24	3	25	4			19	1	20	0		
July 3...	33	1	34	4			25	2	24	6			21	0	19	9		
,, 10...	33	4	34	2			25	10	24	9			19	4	20	0		
,, 17...	33	6	34	1			24	9	24	2			20	5	19	10		
,, 24...	33	10	34	0			24	1	24	7			20	8	19	9		
,, 31...	34	1	34	2			24	5	25	9			20	3	19	8		
Aug. 7...	34	1	34	9			24	9	25	2			19	0	19	1		
,, 14...	34	3	40	3			24	7	29	4			18	7	25	1		
,, 21...	33	7	38	9			26	5	29	10			18	8	24	3		
,, 28...	32	7	36	2			29	0	30	3			17	10	23	5		
Sept. 4...	31	11	36	5			30	11	30	6			17	8	23	9		
,, 11...	31	9	37	10			31	5	29	11			18	0	23	11		
,, 18...	31	7	38	3			30	9	29	5			17	11	23	8		
,, 25...	31	6	37	6			30	1	29	3			17	9	23	3		
Oct. 2...	31	3	37	1			29	9	29	1			17	10	22	9		
,, 9...	31	0	36	8			29	1	28	10			17	10	22	5		
,, 16...	30	11	36	7			28	8	28	8			17	9	22	4		
,, 23...	30	7	37	2			28	7	28	7			18	0	22	5		
,, 30...	30	1	37	10			28	2	28	3			17	9	23	7		
Nov. 6...	30	0	38	8			28	1	28	6			17	9	23	7		
,, 13...	30	1	39	8			27	8	29	0			17	11	24	8		
,, 20...	30	4	41	0			27	5	29	8			18	1	25	5		
,, 27...	30	9	41	11			27	0	30	3			18	4	25	8		
Dec. 4...	31	2	42	2			26	8	30	2			18	4	25	9		
,, 11...	31	2	42	1			26	5	29	11			18	6	25	9		
,, 18...	31	2	41	7			25	11	29	8			18	5	25	9		
,, 25...	31	0	43	3			25	10	29	9			18	4	25	11		

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of March, 1914 and 1915.

—	Wheat.				Barley.				Oats.			
	1914.		1915.		1914.		1915.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
London	32	5	56	5	24	10	33	0	19	4	32	6
Norwich	31	1	54	5	25	7	33	9	18	0	31	1
Peterborough	30	11	53	11	25	3	31	10	18	2	30	9
Lincoln	31	8	55	3	26	2	30	11	19	5	30	5
Doncaster	31	7	53	4	25	2	30	8	18	9	29	7
Salisbury	30	7	53	4	25	6	33	11	18	3	33	4

ADDITIONS TO THE LIBRARY.

Field Crops—

Vermont Agricultural Experiment Station.—Bull. 172 :—Place-Effect Influence on Seed Potatoes. (195-216 pp.) Burlington, Vt., 1913. [63.512(04).]

U.S. Department of Agriculture.—Bull. 182 :—Agricultural Alcohol : Studies of its Manufacture in Germany. (35 pp.) Washington, 1915. [663.5.]

Veterinary Science—

Hindle, E.—Flies in Relation to Disease : Bloodsucking Flies (398 pp.) Cambridge : University Press, 1914. 12*s.* 6*d.* net. [59.169(*a*).]

Herrick, G. W.—Insects injurious to the Household and annoying to Man. (470 pp.) New York and London : The Macmillan Co., 1914. 7*s.* 6*d.* net. [59.169(*c*) ; 63.27(02).]

Imperial Department of Agriculture for the West Indies.—Pamphlet Series No. 77 :—Erysipelas (Epizootic Lymphangitis) and Husk or Hoose. (13 pp.) Bridgetown, Barbados, 1914. 2*d.* [619.1 ; 619.2.]

Mississippi Agricultural Experiment Station.—Tech. Bull. 5 :—Sero-Diagnosis of Pregnancy in Mares. (8 pp.) Agricultural College, Mississippi, 1914. [6.9.1.]

U.S. Department of Agriculture.—Bull. 106 :—The Granular Venereal Disease and Abortion in Cattle. (57 pp.) [619.2(*a*).] Bull. 131 :—Repellents for Protecting Animals from the Attacks of Flies. (26 pp.) Washington, 1914. [59.169.]

Vermont Agricultural Experiment Station.—Bull. 174 :—Methylene Blue : A Remedy for Infectious Abortion. (315-327 pp.) Burlington, Vt., 1913. [619.2(*a*).]

U.S. Department of Agriculture, Bureau of Animal Industry.—Order No. 211 :—Regulations governing the Meat Inspection of the United States Department of Agriculture. (97 pp.) Washington, 1914. [614.31.]

U.S. Department of Agriculture.—Bull. 166 :—Ophthalmic Mallein for the Diagnosis of Glanders. (11 pp. + I. plate.) Washington, 1915. [619.1(*a*).]

Economics—

Co-operative Reference Library.—Misc. Publn. 2 :—Co-operative Mills and Bakeries. (50 pp.) Dublin : The Plunkett House, 1915. 6*d.* [334.6 ; 664.6.]

Central Translations Institute.—Russian Equivalent Tables. London : Danes Inn House, 265, Strand, W.C., 1915. 1*s.* net. [389.]

(3503) Wt. P. 16—9. 7,250. 4/15. J. T. & S., Ltd.

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 2.

MAY, 1915

CLOTTED CREAM.

WILFRID SADLER.

Macdonald College, Quebec, Canada.

IN the counties of Devonshire and Cornwall the dairy industry is of paramount importance. A great amount of milk is produced and sold as such for consumption, but the chief interest attached to the industry lies in the fact that for generations these counties have been renowned for a particular variety of cream known as "Clotted Cream."

Historically, the industry is of more than passing interest, for there is good reason to believe that in some districts in Devonshire cream has been made for centuries. Twamley, famous as one of the earliest authentic writers on dairying in England, says, in a communication to the "Bath and West Society," dated 1791: "From the method used of heating the milk, is produced what is called 'clouted cream'; which I suppose should be termed 'clotted cream,' as the warmth causes the cheese particles to incorporate with the cream, makes it clot and become more mucid or slimy."

Very little information on clotted cream has been published, and no experimental work, designed to improve the standard methods of production, seems to have been carried out.

During the summer of 1912 the writer was deputed by the College with which at that time he was connected—The Midland Agricultural and Dairy College—to conduct an enquiry on the spot on behalf of the Board of Agriculture and Fisheries. The immediate reason for the investigation was as follows:

Information had been received that some farmers and dairymen made a point of adding a small quantity of water to the milk before setting the pans for the cream to rise, their contention being that by so doing the raising of the cream was facilitated and the milk was less likely to adhere to the bottom of the pan and become in some cases "burned."

Until comparatively modern times the milk which remains in the pan after the removal of the cream, and which is known as "scald milk," was used exclusively for the feeding of calves, and that being so the addition or non-addition of water to the original milk did not seem to be a matter of very grave importance. As the public demand for milk increased, however, the more enterprising dairymen saw that "scald milk," containing as it did such a valuable percentage of protein matter, as well as about 1 per cent. of butter fat, was a marketable commodity, and a considerable business was established in the selling of scald milk to certain sections of the population in Devonshire and Cornwall.

This new use for scald milk, which had formerly been regarded as an unimportant by-product, altered the position in respect of the addition of water to the original milk; for it meant that the public were purchasing milk to which extraneous water had been added and therefore milk which in the eye of the law was adulterated. It became, therefore, of importance to ascertain whether the addition of the water was essential for the production of the best quality cream.

In the course of the enquiry an attempt was made to investigate other points of interest to the industry, *e.g.*, the claim that typical "clotted cream" could only be made in the two counties. This was said to be due in some measure to the special nature of the local pastures, but principally to the breeds of cattle kept by the Devonshire and Cornish farmers. In the Exeter district, for instance, the herds chiefly in favour are Jerseys, North Devons and various crosses of these breeds; in the South of Devonshire, South Devons (South Hams) and crosses of these with Guernseys are more common; while in North Cornwall the herds consist principally of North Devons and various crosses.

As the College herd at Kingston was composed almost solely of high class Dairy Shorthorns, the opportunity seemed favourable for observing the influence of the breed of cattle on the quality of typical "clotted cream." The opportunity was also taken to collect information regarding the chemical composition of "clotted cream" and "scald milk."

Throughout the experiments, the original milk, the clotted cream, and the resulting scald milk were weighed and analysed. As the milk was usually set to cream in the evening, a rich milk was secured, closely approaching in quality that used by the Devonshire and Cornish makers.

Before commencing the experimental work, suitable utensils had to be obtained, and a form of apparatus embodying the chief features of the best types in use by makers of clotted cream in the West Country was designed and fitted up in the dairies at the College.*

Briefly, the apparatus consists of a shallow galvanised iron tank, raised on strong iron supports, the cover being of block tin with two holes to receive the pans of milk. The pans are made of block tin, 20–24 in. in diameter at the top, 12–14 in. in diameter at the bottom, and 8 in. deep. Water is contained in the tank, and the heating effected by means of steam passing through pipes direct into the water, the conducting pipes being arranged in such a manner as to avoid undue vibration. Arrangements were made for two pans to be scalded simultaneously under identical conditions, one pan containing milk alone, and the other containing milk with the addition of varying quantities of water. In each test two pans were subjected to the scalding process, one of which was always "normal" and acted as a "control" upon the other. While occasionally a smaller quantity of milk was set for creaming, the usual amount was six quarts in each pan.

The milk to be used was thoroughly mixed and divided by weight into two equal parts. Into one pan a certain amount of water was poured, and then one half of the milk, while the remaining half of the milk was poured into the control pan.

After an interval of from 12 to 15 hours to allow the cream to rise, the scalding process was carried out. It proved to be desirable that, before the pans were put on, the temperature of the water in the tank should be nearly at boiling point. After a few preliminary trials this temperature was fixed at 195° F. to 200° F., but during the latter half of the experiments an alteration was made, the water being raised to a temperature of 205° F.

The experimental work showed that, other conditions being equal, the most satisfactory results were obtained when a thermometer was used to ensure the adoption of a uniform temperature. This agrees with the experience of the

* It has not been possible to obtain a photograph of the actual scalding appliance as used in the experiments. The apparatus was, however, a combination of the appliances shown in Figs. 3 and 5.

best makers in the West Country, and it is probable that a more general adoption of standard uniform temperatures would result in the production of a better article. It is possible, however, that one standard scalding temperature would not give uniform results in different districts under widely varying conditions.

At the beginning of the experimental work the scalding was allowed to take from 15 to 20 minutes, and the temperature of the milk and cream, when removed from the heating apparatus, varied from 180° F. to 185° F.

After the first four trials a change was made by scalding from 25 to 30 minutes. This length of time was continued throughout and the change was completely justified by the results. During the second half of the experiments the temperature of the cream and milk at the conclusion of the scalding was 187° F., and it was then that the finest samples of cream were secured.

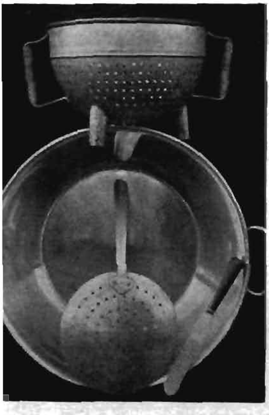
After the scalding was completed, the pans were taken off and allowed to remain for 24 hours, when the clotted cream was skimmed (Figs. 1 and 2). This operation called for great care in order that both the "control" and the experimental

TABLE I.

Analyses.

Date.	No.	Milk.				Scald Milk.		Cream.
1912.		Fat.	Total Solids.	Weight of Milk.	Amount of Water added.	Fat.	Total Solids.	Fat.
		per cent.	per cent.	lb.		per cent.	per cent.	per cent.
July 20 ..	1	4·1	13·18	30	None	0·8	10·25	59·69
„ 21 ..	2	—	—	22	None	1·0	10·41	58·97
„ 22 ..	3	4·5	13·03	20	None	0·8	10·12	56·76
„ 23 ..	4*a*	3·9	12·68	10	None	0·45	10·00	62·65
	4*b*	—	—	10	1 gill	0·45	9·73	61·82
„ 25 ..	5*a*	3·35	12·61	15	None	0·6	10·11	62·61
	5*b*	—	—	15	1 pint ..	0·6	9·29	62·79
„ 25 ..	6*a*	3·7	12·81	15	None	0·75	10·25	64·90
	6*b*	—	—	15	1 quart ..	0·7	8·97	62·83
„ 26 ..	7*a*	—	—	15	None	0·75	10·19	66·27
	7*b*	—	—	15	2 quarts ..	0·60	7·84	68·34
„ 28 ..	8*a*	4·8	13·43	12	None	1·0	10·13	62·54
	8*b*	—	—	12	1 gill	0·9	9·83	64·79
	8*c*	—	—	12	2 gills ..	0·85	9·57	64·40
	8*d*	—	—	12	3 gills ..	0·85	9·41	64·45
„ 30 ..	9*a*	4·7	13·56	15	2 gills ..	0·7	9·97	64·04
	9*b*	—	—	15	None	0·7	10·41	63·47
	9*c*	—	—	12	2 gills ..	0·5	9·75	63·88
	9*d*	—	—	12	None	0·65	10·32	68·59
Aug. 1 ..	10*a*	0·1	9·06	15	None	0·5	10·00	62·59
	10*b*	0·05	9·23	15	None	0·4	9·68	64·23
„ 1 ..	11*a*	4·3	13·24	15	None	0·9	10·21	64·10
	11*b*	—	—	15	2 gills ..	0·9	9·83	64·42
„ 2 ..	12*a*	4·55	—	15	None	0·9	10·16	62·67
	12*b*	—	—	15	1 pint ..	0·8	9·35	62·92
„ 3 ..	13*a*	4·7	13·53	15	None	1·05	10·25	64·72
	13*b*	—	—	15	1 quart ..	0·95	8·90	65·37
„ 4 ..	14*a*	4·25	12·89	15	None	0·6	10·02	64·56
	14*b*	—	—	15	1 quart ..	0·65	8·64	64·76
„ 5 ..	15*a*	4·5	13·07	10	None	0·7	9·97	59·47
	15*b*	—	—	10	2 gills ..	0·8	9·48	58·05
„ 6 ..	16*a*	4·8	[illegible]	10	None	0·95	10·59	60·35
	16*b*	—	—	10	1 gill	0·85	10·18	61·17

FIG. 1.—Skimming the Cream in a West-Country Dairy.



IG. 2.—Some of the Utensils used in the Process:—Three-legged Cream Drainer; Pan in which Milk is set and scalded; Skimmer; Palette Knife.

FIG. 3.—Steam Scalding App with 2 Pans of Milk in p The Cooling Room may be the background.

pans should be skimmed under the same conditions. Any excessive mixing and stirring of the cream for sampling was liable to destroy the texture, and there was the danger of converting it into butter. In addition to the samples for analysis, samples were also taken for the purpose of judging the flavour, texture, and general marketable quality of the cream. The results of the analyses are shown in Table I.

One of the advantages claimed by those who favour the use of water in the milk is that the sediment, consisting of white specks found in the bottom of the pans when the scald milk is poured away, is considerably less in the pans containing some amount of water than it is in those containing normal milk. The College experiments proved, however, that water on the bottom of the pan has no influence on the proportion of sediment remaining after the scald milk is removed. In fact, on some occasions there was actually more sediment from the watered milk than from the normal milk.

There was no appreciable difference between the weight of cream skimmed from the normal milk and the weight of cream from the watered milk.

The average weight, taking both the experimental and "control" pans, worked out at 10·39 oz. cream from 15 lb. of milk, which shows that 1 lb. of clotted cream is produced from 23 lb. of milk. The Devonshire makers consider that 1 lb. of clotted cream is obtained from 20·5 lb. of milk, but no experimental data are available to bear out that opinion, and, having regard to the difference in breeds of cattle, the yield of cream obtained in the College experiments does not appear to compare unfavourably with the accepted figures of the West Country makers.

Some makers have contended that the addition of water assists in the production of a cream having the most typical and desired flavour, and, as from the commercial aspect this is obviously a matter of great importance, the samples of cream when skimmed were judged for flavour at the College by Mr. Alec Todd, Head of the Dairy Department, and by the writer. It was found invariably that the cream obtained from watered milk was inclined to be insipid and lacking in flavour as compared with the normal cream. The importance of this phase of the enquiry appeared so great that, as soon as a uniform method could be arrived at, arrangements for judging were made with two Devonshire producers, both of them engaged commercially in the business, and one of them being a well-known exhibitor of cream and holder of many of the highest

awards. The samples were posted to them as early as practicable, and would usually arrive some 24 to 36 hours after skimming. For this purpose the creams were simply labelled A and B, respectively, and no particulars were given to the judges as to the character of the samples.

Abstracts from the reports of these gentlemen are as follows, and further particulars as to the respective samples may be gathered from the tables :—

9*d* (no water) ..	" Best specimen yet seen, and 9*c* a close second. Granulation all right, but each lacks the characteristic flavour."
10*a* ,, .. 10*b* ,, ..	" Samples 10*a* and 10*b* are the thing."
11*a* ,, ..	" To me a very good cream, the flavour and texture as much like our cream as you will get. I think if you produce cream like that you will have a very saleable article."
11*b* (2 gills water)	" Arrived 48 hours after skimming, and both quite sweet. Did not like this sample. Seemed like separated cream scalded, being too pasty. Not much flavour, in fact did not care for it at all."
12*a* (no water) .. 12*b* (1 pt. water)	" Both typical—2½ days old. Sample 12*a* very nice and sweet, and sample 12*b* developing bitterness."
12*a* (no water) .. 12*b* (1 pt. water)	" Consider them both good, but prefer 12*a* on account of flavour."
13*a* (no water) .. 13*b* (1 qt. water)	" Both typical with no striking difference—after 36 hours sample 13*a* still very nice and sweet, while sample 13*b* has a slight suggestion of bitterness."
13*a* (no water) .. 13*b* (1 qt. water)	" Think them both good—very little difference in them, 13*a* possibly being a little better in flavour "
14*a* (no water) .. 14*b* (1 qt. water)	" Both are all right and quite typical, but I think sample 14*a* has the better flavour."
14*a* (no water) .. 14*b* (1 qt. water)	" Both good. Sample 14*a* good in flavour and texture very good. Sample 14*b* not so good in texture, being a little pasty, and not quite so good flavour as 14*a*."

The samples submitted represented cream produced from milk containing quantities of water varying from 2 gills to 1 quart per lot of milk, and in each case the cream from the corresponding " control." It will be noticed that opinion was invariably in favour of the sample of cream produced from milk to which no water had been added.

As regards the qualities required in a typical sample of clotted cream, it must be granular in texture ; it should be firmer than the thickest of cream obtained from a separator, but not so firm as a freshly-made cream cheese ; the colour

should be golden, not unlike the colour of the butter made from pure bred Guernsey cows. The cream must not be too wet or "mushy," for, if so, it ceases to be characteristic; moreover if too much moisture is present it indicates an excess of scald milk incorporated in the cream, and the keeping qualities are thereby considerably impaired. The cream must have a "nutty" taste, and a decided scalded flavour pleasing to the palate.

A reference to Table I. indicates that the percentage of butter-fat in the original milk cannot have any considerable influence upon the percentage of butter-fat in the finished cream owing to the method of skimming which at present prevails; but it may be inferred that, other conditions being equal, the richest and finest cream is likely to be obtained from the richest milk.

Table II. gives the percentage of "Butter-fat," "Total Solids," and (by deduction) the percentage of "Solids not Fat" in the scald milk obtained from the normal milk.

TABLE II.
Scald Milk.

Samples (without water).	Butter-Fat.	Solids not Fat.	Total Solids.
	Per cent.	Per cent.	Per cent.
1	0·80	9·45	10·25
2	1·00	9·41	10·41
3	0·80	9·32	10·12
4*a*	0·45	9·55	10·00
5*a*	0·60	9·51	10·11
6*a*	0·75	9·50	10·25
7*a*	0·75	9·44	10·19
8*a*	1·00	9·13	10·13
9*b*	0·70	9·71	10·41
9*d*	0·65	9·67	10·32
10*a*	0·50	9·50	10·00
10*b*	0·40	9·28	9·68
11*a*	0·90	9·31	10·21
12*a*	0·90	9·26	10·16
13*a*	1·05	9·20	10·25
14*a*	9·60	9·42	10·02
15*a*	0·70	9·27	9·97
16*a*	0·96	9·64	10·59

Table III. shows the complete analyses of the samples of cream raised and taken from the normal milk; it will be seen that the percentage of butter-fat in clotted cream may be as high as 66·59 per cent., the more usual percentage being, however, in the region of 62–64 per cent.

TABLE III.

Clotted Cream.

Samples (without water).	Water.	Butter-Fat.	Solids not Fat.	Total Solids.	Protein.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	35·46	59·69	4·85	64·54	3·07
2	33·05	58·97	7·98	66·95	3·00
3	37·29	56·76	5·95	62·71	3·45
4*a*	32·87	62·65	4·48	67·13	3·51
5*a*	31·03	62·61	6·36	68·97	3·58
6*a*	28·10	64·90	7·00	71·90	3·64
7*a*	27·94	66·27	5·79	72·06	3·19
8*a*	29·68	62·54	7·78	70·32	2·94
9*b*	28·15	63·47	8·38	71·85	2·62
9*d*	27·57	66·59	5·84	72·43	3·58
10*a*	30·18	62.59	7·23	69·82	3·26
10*b*	29·06	64·23	6·71	70·94	3·19
11*a*	30·40	64·10	5·50	69·60	3·26
12*a*	31·46	62·67	5·87	68·54	3·64
13*a*	27·87	64·72	7·41	72·13	3·45
14*a*	29·90	64·56	5·54	70·10	3·39
15*a*	33·28	59·47	7·25	66·72	3·77
16*a*	31·74	60·33	7·93	68·26	4·09

During the course of the investigation a number of bacteriological problems suggested themselves, and of these the most important appears to be the explanation of the derivation of that unique flavour so characteristic of the best samples of clotted cream. While the actual scalding process is to a great extent responsible for the specific flavour, there is every reason to believe that, even before the scalding takes place, the flavour has in a great degree been decided.

During the time which elapses between the setting of the milk for creaming and the scalding, bacterial action is taking place, and the various organisms present are exerting an influence upon the flavour of the milk itself. When the scalding begins, the currents which are set up in the milk and cream tend to distribute the bacteria evenly throughout the whole, and the flavours which are the result of volatilisation are taken up and retained in the cream.

The scalding process is essentially a system of pasteurisation, the efficiency of which depends largely upon the types of the bacteria which comprise the original flora of the milk.

Such organisms as are able to resist the temperature employed in the heating will be free to multiply in the period of twenty-four hours during which the milk and cream are left to cool; and, as they will be present in the cream as well as in the

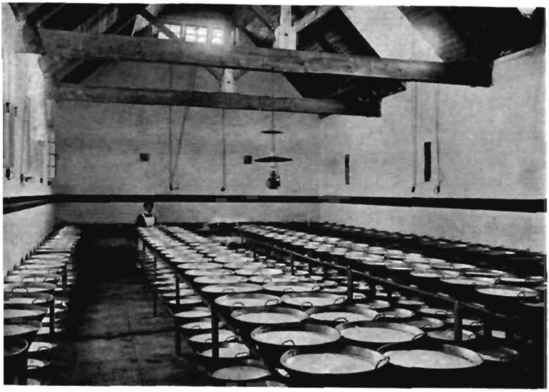


FIG. 4.—Cooling Room of a large Dairy.

FIG. 5.—Cooling Room of Dairy referred to in Fig. 6.

scald milk, the flavouring of the cream may vary according to the types and number of the bacteria which have survived the heating.

Some support is lent to this by a consideration of the reports on certain of the samples of cream produced during the investigation at the Midland College. It will be noticed that in each case the flavour of the sample which had been taken from the cream raised on normal milk was considered the better, *e.g.*, in samples 12*b* and 13*b* there was a distinct bitterness, while in samples 12*a* and 13*a* no such taint was discernible.

Having taken these samples at the same time, and knowing that the milks, normal and watered, had been subjected to identical conditions in every respect, the writer was led to infer that some organisms present in the water had survived the scalding process and were, in some measure at any rate, responsible for the flavouring detected. The scope of the work at the time did not, however, allow of bacteriological examinations being made either of the water, the milk or the cream.

The investigation also indicated that the keeping properties of clotted cream are greater than is sometimes supposed. Many who are engaged commercially in the industry express the opinion that cream should be consumed within about 24 hours after skimming, but it will be seen that some of the samples submitted were quite good and typical for periods of 36, 48, and 60 hours after skimming.

The question of the keeping qualities of clotted cream is second only in importance to flavour, and it should be possible by a further investigation to obtain some useful information on this point.

The results of the experiments conducted thus far tend to show that :—

1. From normal milk clotted cream can be produced superior in flavour and texture to that produced from milk to which a quantity of water has been added.

2. The addition of water does not appreciably add to the actual weight of cream produced and does not appear to affect the percentage of fat in the cream.

3. The use of water in the bottom of the creaming pan has no influence whatever on the amount, or, as far as can be seen, the nature of the sediment which remains in the pan after the removal of the scald milk.

4. The clotted cream produced from milk to which water has been added does not possess the keeping qualities of similar cream raised from normal milk.

5. As regards the effect upon the by-product, the position appears to be that, while depreciating both the food and the commercial value of scald milk, no corresponding advantage can be shown to result from the use of water either as concerns the scald milk or the clotted cream. In fact, the experiments tend to prove that there are sufficient disadvantages to warrant a discontinuance of the practice.

6. Provided a suitable system be adopted and reasonable care be taken in management and manipulation, clotted cream, having the typical and characteristic properties, can be produced in any district.

7. While a rich milk is preferable, it is not at all essential for the production of characteristic clotted cream that only the breeds favoured by the agriculturists of the "West Country" should be employed.

8. The flavour and the keeping properties of clotted cream are problems of a bacteriological nature.

Methods in Vogue in Devonshire and Cornwall.

It may be of interest in concluding this article to give some account of the methods adopted in making clotted cream in its native counties. As a first example, a modern dairy in the neighbourhood of Exeter may be mentioned. Here it may be noted that the milk is poured into the pans, and, after standing for some 10–12 hours, is scalded. For this purpose the dairies are fitted with long copper troughs to accommodate the water, with steam connections for the heating (Fig. 3). Covers made of copper fit on the top, and these are hollowed in such a way as will admit of the pans being supported and at the same time surrounded by the water. The steam is turned on and when the water has been brought to the boiling point the pans are put on. The temperature of the milk and cream is not usually allowed to go higher than 190° F., and the operation is completed on the average in about 15 minutes.

A thermometer is used, but experienced dairymen often tap lightly the rim of the pan and if small bubbles rise on the surface of the cream, consider that the scalding is completed. The pans used are large enough to deal easily with two gallons of milk.

From the scalding-room the pans are taken to a cooling room (Fig. 4), and about 24 hours later the cream is taken off and lifted into a metal strainer by means of specially adapted skimmers. These skimmers have long handles and small perforations. The bottom and sides of the metal strainer

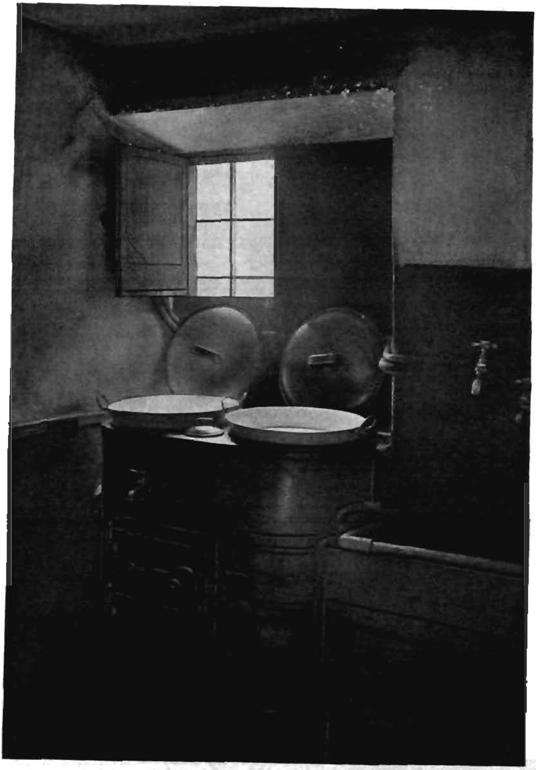


FIG. 6.—"Furnace and 'Copper.'" Scalding Apparatus as used in a well known Newton Abbot Dairy.

are perforated in order to permit of the thinner cream passing away, leaving only the typical thick cream in the vessel. The cream which passes through the perforations is utilised for butter-making.

The cream having been skimmed is ready for sale at once, and for the purpose of transit is packed into small earthenware jars or in tins. A type of vessel which is now coming into vogue for use as a receptacle for cream is the wood pulp cup.

Some idea as to the possibilities of the clotted cream industry may be gathered from the fact that, in one large dairy in this part of Devonshire, no less than one ton of cream is made and distributed each day during the season.

A well-known maker in the vicinity of Newton Abbot uses a "copper" the water in which is heated underneath by a furnace (Fig. 6). His pans are of enamelled metal (Fig. 5) and the scalding process is conducted for from 30–45 minutes. The temperature of the water in the copper at the conclusion of the process is about 212° F.

In Plymouth, one large dairy deals with the milk of 250 cows; the pans for scalding are placed on steam-heated water, which is at the boiling temperature before operations are commenced, and then the heating is continued for from 15 to 17 minutes. Two other dairies of considerable size adopt a similar treatment, the heating being continued 15 minutes and 25 minutes respectively.

In North Cornwall there are to be seen one or two examples of the old-fashioned dairies, and in these cases, it was often stated that the addition of water prevented "catching." It was on the moors not far distant from Camelford that an opportunity presented itself of seeing the production of clotted cream under conditions in which the heating was done by means of peat fuel, cut from the moors on the homestead. This was the only instance in the whole of the enquiry where the writer succeeded in finding this method of heating.

The farm in question was a lonely homestead on a wide expanse of Cornish moor. The atmosphere of the room in which the dairy operations were carried on was redolent with the smell of peat. The fireplace was old and contained no range of any description, the fuel consisting solely of peat. This is allowed to burn and smoulder until little remains except the red and glowing embers. These are put into an iron pot supported on a tripod, and on the pot is placed the small crock of milk. The supply of smouldering peat is kept constant and in from 1½ to 2 hours the "scalding" is completed.

The cream raised in this manner is unique and has a flavour of its own bearing a resemblance to the odour of smouldering peat. Even to-day there are often connoisseurs of "clotted cream" who are not satisfied with any other than cream heated over a fire of peat.

The author wishes to acknowledge his indebtedness to Dr. Wm. Goodwin, Principal of the Midland Agricultural and Dairy College, for his advice and warm interest; to Mr. Alfred Appleyard, M.Sc., now of the Rothamsted Experimental Station, who conducted the whole of the analyses upon which the tables are based; to Mr. A. O. Rowden, of Exeter, and Mr. J. Dolbear, of Newton Abbot, for their services during the later investigation; and to the producers of clotted cream in Devon and Cornwall for their courtesy and assistance during the preliminary enquiry.

REFERENCES:

1. Soft Cheesemaking, by C. W. Walker Tisdale and T. R. Robinson (London: John North).
2. Jour. Bd. of Agr., Vol. xiii., 4, pp. 214, 215; Vol. xvi, 2, pp. 130, 131; and Vol. xx., 5, p. 385.
3. Board of Agr. and Fisheries. Annual Rep. Intell. Div. Pt. 1. 1912.

SOIL ANALYSIS.

E. J. RUSSELL, D.Sc.,
Rothamsted Experimental Station.

ANALYSIS is the method adopted by the expert adviser for obtaining certain information about a soil. It includes chemical, physical and bacteriological investigations, and it may be accompanied by more general field observations for the purpose of discovering the nature of the subsoil, of the water supply, and of the climatic and other conditions important for the growth of plants.

A full investigation of this kind is found to be too laborious for ordinary use, and in practice shorter methods are commonly necessary. These do not aim at giving a complete account of the soil, but they express the amounts of certain substances present which are known to have an important effect on crop production. Experience has shown, however, that these methods are at their best when used for purposes of comparison, and as far as possible they should only be applied in this way. The analysis of a casual sample of soil from a district of which

the analyst has no intimate knowledge is a much more difficult affair, and is often unsatisfactory both to him and to the farmer. Indeed, from the farmer's point of view, the question as to whether a soil analysis is worth conducting depends very largely on the possibility of making a comparison with some similar soil about which definite knowledge has been obtained by field experiments.

Fortunately, this country is now provided with organised schemes under which such systematic field experiments may be made and the results recorded; the possibility of setting up comparisons is therefore steadily increasing.

How a Soil Analysis may be Useful.

In at least three distinct cases useful help can be given by the soil expert.

(1) The simplest case arises when a farmer wants to know whether he has any reasonable chance of obtaining results similar to those demonstrated by field experiments on another farm in his locality. Where, for instance, such experiments have demonstrated the advantage of applying lime, phosphates, or potash, the expert can with considerable accuracy say whether similar results can be obtained on the farm in question. He cannot be absolutely certain, as there is always an unknown factor, but the chances are that he comes out right. There is no doubt that much more use might be made of field experiments in this way with considerable gain both to farmers and the officers advising them.

(2) Another comparatively simple case arises when a farmer wishes to adopt some system of cropping or soil treatment known to give good results elsewhere in the locality, but before embarking on the change he desires to know how far his soil conditions resemble those where the method works well. Here examination may reveal some difference which, while not very obvious to casual inspection, is of vital importance to the success of the enterprise. Two heavy soils, for instance, may look very much alike, but one may owe its heaviness to very fine particles and the other to silt particles. Methods that succeed in one case have often failed in the other. If the farmer is aware of the difference he can make his plans accordingly.

(3) The problem is rather more extensive when a man is entering on a new farm and wants to obtain as complete information as possible about the soil. Here the farmer must remember that no one person can possibly give him all the

information that could be gleaned ; chemists, bacteriologists, physicists, could each say a good deal without exhausting the subject. A selection has to be made, and much time is saved where an interview can be arranged on the spot with the expert consulted, who can then ascertain exactly what information is wanted. Most farmers feel that they have a bent for some special branch of production, and they naturally wish to exercise their powers in the right direction.

On the other hand, many soils have some special feature fitting them for some particular crops better than for others. A certain amount of accommodation is possible on both sides : The farmer may alter both his scheme and his soil, and the best results cannot be obtained till the process is complete and the scheme made to fit the possibilities of the soil. This end may be and often is attained by the costly and bitter method of experience ; it can, however, often be reached more quickly by securing the services of the expert. In the first place an investigation will show whether the soil and the general conditions resemble those obtaining where the proposed system of husbandry is known to be a success. It may reveal the more important differences and enable the farmer and the expert to discuss methods by which they may be overcome. Secondly, a comparison of the results with others obtained in the locality will show the expert to what type the soil belongs, and he can then inform the farmer what systems of farming are known to succeed on this type. Thus the materials for a comparison can be got together. Although no one would pretend that anything like complete information could be obtained in this way it is certain that money and valuable time can often be saved.

Difficulties.

The problem becomes much more difficult directly the soil expert gets away from comparisons and is asked to make an absolute pronouncement on a sample of soil considered by itself. Of course, if he has considerable local knowledge, or if a soil survey of the district has been made, he may discover a standard of comparison and then matters proceed tolerably smoothly. Failing this, he feels that his ground is very uncertain ; he has to try and put some absolute value on the quantities obtained by analysis, and in interpreting the results a good deal of balancing of probabilities becomes necessary ; this is always a delicate business and is likely enough to miscarry.

Still more difficult is the case when the farmer does not ask for definite information on specific points, but puts the general (and natural) question—How can I manure my land at greater profit than I am getting at present ? Although every farmer must ask himself this question he will, after careful thought, quickly realise that it is much too complex to be answered off-hand. The analyst may be able to report that similar soils under similar conditions have given satisfactory returns for the application of certain manures to certain crops ; but the question whether equal returns would be satisfactory on the farm in question depends on many other factors—the amount of capital available, the market facilities, the general economy of the whole farm, &c.—and a satisfactory answer can usually only be obtained when the whole question has been discussed by the farmer, the agricultural expert and the soil expert. Short of this the best method is for the analyst to suggest two or three systems of manuring, and for the farmer to give them as good a trial as possible before making the final selection. This problem, of course, becomes more and more easy as the number of analyses is multiplied, but it continues to be very difficult until the expert's work is well organised.

Conclusions.

The farmer who wishes to derive the maximum assistance from soil analysis must bear the following points in mind :—

1.—The simplest problem for the expert is to compare soils, and, therefore, the chances of success are greatest when a soil survey has been made or when some similar soil has been under proper field experiments.

2.—The object of the analysis is to furnish information, but no one has the time, even if he had the power, to set out all that can be discovered about a particular sample of soil. The farmer must, therefore, arrange to go over the land with the expert and discuss on the spot the various points on which information is desired ; the necessary samples can then be drawn with the proper tools and with all due precautions.

3.—Finally, it should be remembered that the problem is very difficult indeed when no satisfactory standards exist, and where the expert has not made a personal inspection ; so much balancing of probabilities has to be done that no expert can give more than a general opinion or do more than submit two or three alternative schemes for consideration and trial.

THE FEEDING OF LINSEED TO CALVES.

S. HOARE COLLINS, M.Sc.

Agricultural Department, Armstrong College, Newcastle-upon-Tyne.

LINSEED in one form or another is in general use for calf feeding on farms where it is the practice to sell the bulk of the milk, or where the milk is largely used for cheese-making, or where butter is made and only skim milk or separated milk is available. Crushed linseed may suitably be added to skim or separated milk for calf feeding, but linseed cake meal (*i.e.*, ground linseed cake) would usually contain insufficient oil for the purpose, especially for feeding with separated milk. When little or no skim milk is available, calf meal containing only a moderate proportion of linseed should be used; crushed linseed alone would be too oily, and linseed cake meal alone too rich in albuminoids.

Linseed is a very good and very safe food when properly used, but its preparation requires some care, since a poison—prussic acid—may be formed if the conditions are such as to bring together two substances present in the seed, viz., an enzyme and a substance known as *Linimarin.*

1. In the first place different kinds of linseed vary according to their origin in respect of the amount of poison which is capable of being produced from them. As a rule linseeds grown in England are less poisonous than those grown in hotter climates.

2. In the second place, with linseed cake, the amount of prussic acid which may be formed will vary with the treatment of the seeds previous to the expression of the oil. If the seeds are only subjected to a gentle dry heat, the removal of the oil has the effect that the poison (together with the other remaining constituents of the seeds) is greater proportionately in the cake than in the seeds. If the seeds are subjected to both steam and heat, the enzyme is either destroyed or at least decreased in amount, and the rate at which the poison will be formed is diminished.

It happens that, while containing more poison, linseed grown in hot climates contains less water than English-grown linseed, and this renders it necesssary for the manufacturer to use steam before pressing the seeds, thus unconsciously counteracting the higher proportion of poison. The extent to which this counteraction takes place varies, however, so that corresponding variations occur in the cakes produced. In some

cases only a very small proportion of the total amount of the poison is liberated. There is, however, no linseed meal which contains so much Linimarin that it could not be rendered quite harmless if fed in a proper manner.

3. In the third place, it may be assumed for all practical purposes that there is extremely little risk of adult animals in good health being poisoned, as both their saliva and gastric juice check the development of the poison in the body.

The problem of the prevention of poisoning is thus resolved into the question of the proper preparation of linseed when feeding to young or sick animals.

In this connection it may be definitely stated that so long as the seed is fed whole, or even if it be fed simply crushed, there is no risk of poison forming; but if the seed be both crushed and soaked in water the conditions favour the production of the prussic acid, especially if the linseed is subjected to a dry heat before soaking, in which case the maximum formation of poison takes place. Further, if the linseed in the form of fine meal is partly mixed with warm water so that the meal is in the form of a number of balls, such conditions favour the maximum production of prussic acid inside these balls. If the meal in this form is not properly chewed the balls of meal will break up in the stomach and there liberate the poison.

Boiling water will d. troy the enzyme, thus preventing the formation of prussic a.. l. In preparing the meal for calves or sick animals, therefore, *the linseed should be actually boiled with water* (thus removing all risk of prussic acid formation), or else well mixed with twenty times its weight of water which is absolutely boiling at the time, when the chance of poisoning is too remote for practical consideration. Not more than 1 lb. of linseed should be mixed with a gallon of boiling water; ground linseed and linseed cake meal swell and froth a good a. ith water, and the mixture should be carefully stirred until quite smooth.

It is of advantage to mix a little wheat flour with the linseed meal to counteract the laxative influence of the latter; the wheat flour will also supply some starch, produce a better balanced food, and will not swell so much with water as linseed meal does. Maize meal or oatmeal may be used instead of wheat flour if the laxative effect of the linseed is desirable.

THE PROGRESS OF THE LIVE STOCK INDUSTRY IN DENMARK.

J. J. DUNNE.

Fyns Sprogskole, Odense, Denmark.

THE returns of the quinquennial census of Danish live stock taken on the 15th July, 1914, which were recently published by the Danish Statistical Department, include some interesting facts and figures, and show the increasing importance of live stock in the agriculture of Denmark.

Horses.—The total number of horses and foals on the 15th July, 1914, was 566,811. In 1909 the figures were 535.018. These figures show an increase of some 32,000, or about 6 per cent. in 5 years. The classification as regards age and sex in 1914 and 1909, respectively, was as follows :—

—	1914.	1909.
Stallions, 3 years or over	4,157	3,865
Geldings, 3 to 6 years	53,858	51,687
„ 6 to 11 years	80,721	74,379
„ 11 years and over	54,492	48,590
Total	189,071	174,662
Mares, 3 to 6 years	66,394	59,327
„ 6 to 11 years	96,992	95,185
„ 11 years and over	73,835	70,347
Total	237,221	224,859
Colts, 1 to 2 years	48,909	48,352
„ 2 to 3 years	38,084	33,947
Total	86,993	82,299
Foals under one year	49,369	49,333
Grand Total	566,811	535,018

The figures indicate a greater increase for geldings than for mares, and, of the five groups, those comprising the youngest animals (*i.e.*, colts and foals) show the least increase.

The effective working strength of Danish horses has increased a good deal more than is revealed by the figures quoted. Excluding stallions, the following are the percentages of increase according to age during the last 5 years :—

Under one year	0·1	per cent. increase since 1909.
From 1 to 2 years ..	1·2	„ „ „
„ 2 „ 3 „ ..	12·2	„ „ „
„ 3 „ 6 „ ..	8·3	„ „ „
„ 6 „ 11 „ ..	4·8	„ „ „
Over 11 years ..	7·9	„ „ „

In general, Danish horses are of the draft type. The native breeds are known as the Jutland and the Fredericksborg. Of the foreign breeds found in Denmark the Belgian and the Oldenburg (German) are the favourites. There are few thoroughbred animals in Denmark. The following figures show the increase in the number of horses since 1861:—

1861	.. ..	325,000	1898	.. ..	449,329
1881	.. ..	347,561	1903	.. ..	486,935
1888	.. ..	375,533	1909	.. ..	535,018
1893	.. ..	410,639	1914	.. ..	566,811

Of late years, numbers of ponies have been imported from Iceland and Russia by the Danes. These ponies, which are all under 15 hands in height, might be called the small holder's horse. In 1898 there were 26,000 foreign ponies in Denmark, but since then their number has been more than trebled, there being 87,000 such ponies in Denmark on the 15th July, 1914. About 65,000 of these were Russian, 14,000 were from Iceland and the remaining 8,000 were unclassified.

Cattle.—The great dairy movement of the 'eighties proved to be the turning point in the economic welfare of Danish agriculture, and the following table, which shows the increase in the number of cattle since 1881, will, therefore, be of interest.

Year	Cows of two years and over.	Calves and young stock under two years.	Bulls.	Bullocks	Total.	Number of cattle per 1,000 acres under cultivation *	Number of cattle per 1,000 of population †
1881	898,790	458,743	17,959	94,598	1,470,078	210	736
1888	954,250	435,988	14,980	54,309	1,459,527	208	681
1893	1,011,098	603,949	17,954	63,194	1,696,190	242	762
1898	1,067,265	628,025	15,324	34,183	1,744,797	250	731
1903	1,089,073	699,354	14,528	37,511	1,840,466	263	734
1909	1,281,974	840,750	73,039	58,219	2,253,982	322	834
1914	1,310,268	988,554	95,568	68,472	2,462,862	352	861

* There are nearly 7 million acres of land under cultivation in Denmark.

† The population of Denmark increased from 1,995,000 in 1881 to 2,859,000 in 1914.

In the course of the last 33 years the total number of cattle has increased by about 992,780 head or 67½ per cent. When the first cattle census was taken in 1837 there were only 858,000 head of horned cattle in Denmark, so that the number of cattle in 1914 was nearly three times that of 1837. In round figures it may be said that between 1837 and 1870 the average increase was about 9,000 head annually; and from 1870 to 1881 it was 20,000 head annually. Between 1881 and 1888 the average annual increase dwindled slightly, but from 1888 to 1893 it approached the high figure of 50,000 head. This was chiefly due to the great extension of dairying which occurred during the period. From 1893 to 1898 the average annual increase was about 10,000 head, and from 1898 to 1903 about

20,000 head. The increase between 1903 and 1909, *i.e.*, an average of 70,000 head annually, surpassed all previous records, while the increase during the last 5 years (40,000 head per annum), although not so great as that of the preceding 5 years, constitutes, nevertheless, a very satisfactory record.

In 1881 the number of cattle per 1,000 acres of land under cultivation was 210, while in 1914 it was 352, an increase of 142 head per 1,000 acres, or nearly 68 per cent. in 33 years. In 1881 the number of cattle per 1,000 of population was 736, while in 1914 it was 861, an increase of 125 head per 1,000 of population, or 17 per cent. during the period.

Dairy Cows.—Of the total number of Danish cattle in 1914, no fewer than 1,310,268 were either cows or heifers that had calved for the first time. These figures show an increase of 28,294 or 2·2 per cent. in the last 5 years. As the following figures show, many very important changes have taken place with regard to the ages of the dairy cows during the last 5 years :—

Age.	1914.	1909.	Remarks.
Under 3 years ..	220,020	700,557	14·1 % increase.
From 3 to 6 years ..	579,302		
From 6 to 10 years ..	429,434	484,343	12·8 % decrease.
Ten years and over ..	81,512	97,074	19·1 % „
Total ...	1,310,268	1,281,974	2·2 % increase.

It will be noted that the number of young cows has increased very considerably, while there has been a sharp decline in the old cows during the period. The increase of all the groups (28,294) is mainly due to the fact that 15,562 old cows over 10 years of age and 54,909 from 6 to 10 years of age were fattened and sold and the total (70,471) replaced by 98,765 young cows less than 6 years old. This replacement of old cows by young ones is an important result of the keeping of milk records, which aim at getting rid of the old, badly-paying cows having low percentages of fat in their milk, and replacing them with young, vigorous stock having high percentages of fat in their milk. The following table gives an idea of the extent to which this policy has been carried out since 1898 :—

Age.	1898.	1903.	1909.	1914.
	Per cent.	Per cent.	Per cent.	Per cent.
Under 6 years ..	83·5	43·4	54·6	61·0
From 6–10 years ..		42·2	37·8	32·8
Over 10 years	16·5	14·2	7·6	6·2

Sixteen dairy cows in every hundred were over 10 years old in 1898, while in 1914 the percentage of cows over the age of 10 years was reduced to 6. In 1903 a little more than two-fifths of the cows were under 6 years of age; in 1914 three-fifths were under 6 years of age.

The official dairy report published in 1913 gives particulars of the production of 722 dairies, or about two-thirds of the Danish co-operative dairies. The following table shows the average yearly milk yield per cow during the 5 years ending 1913, together with the average quantity of milk required to produce 1 lb. of butter :—

Year.	Average annual milk yield per cow.		Lb. of milk to 1 lb. butter.
	in lb.	in Imp. gals.	
1899	*4,764*	*467·0*	*26·3*
1909	5,816	570·0	25·3
1910	5,657	556·6	25·6
1911	5,792	568·0	25·5
1912	5,558	545·0	25·6
1913	5,690	558·0	25·5
Average *1909–13*	*5,703*	*560·0*	*25·5*

Comparing the average yield of 1899 with that of the 5 years 1909-13 the figures indicate an increase of nearly 20 per cent. in the average milk yield per cow. This excellent progress demonstrates in a striking manner the economic value of the keeping of milk records. The decrease in the quantity of milk essential to the production of 1 lb. of butter is mainly due to the increase in the percentage of fat in the milk of the cows. If records are periodically taken, cows having a liberal milk flow with a high fat percentage are singled out, and the selection of such stock for breeding purposes, when persevered in, is bound to increase both the average milk yield and the average fat percentage, as the following records show :—

Cows.	Average milk yield in lb.	Fat in milk %	Average butter yield per cow.
			lb.
68,124 tested in 1903–04	7,044	3·41	267
124,668 tested in 1910–11	7,567	3·52	296
Average percentage of increase ..	*7·4* %	*0·11* %	*10·8* %

Calves and Young Stock.—Of the 988,554 animals grouped under this heading, no fewer than 609,115 were calves, and 379,439 were heifers over one year that had not yet calved. The following table shows the relative figures for 1909 and 1914:—

Age.	1914.	1909.	Increase.
			Per cent.
Calves under one year	609,115	486,781	25·1
Heifers over 1 year not yet calved ..	379,439	353,969	7·2
Total	988,554	840,750	15·7

These figures indicate that large numbers of young animals are available for drafting into the dairy herds. The most recent census form contained a question regarding the numbers of calves dropped between the 15th July, 1913, and the 15th July, 1914, together with an inquiry as to whether the calves had been sold, slaughtered, or had died during the year, or were alive on the census day. From the answers received it appeared that 1,144,000 calves were dropped in the period (*i.e.*, 87 per cent. of the 1,310,268 cows dropped calves). Of these calves 609,115, or 53 per cent., were living on the 15th July, 1914.

Bulls.—During the last 5 years the number of bulls has risen from 73,039 to 95,568, or by 31 per cent.

Age.	1914.	1909.	Remarks.
From 1 to 2 years	68,880	49,009	40·5 % increase.
" 2 to 3 " ..	22,771	19,736	15·4 % "
" 3 to 5 " ..	3,348	3,516	1·9 % decrease.
5 years and over	569	778	26·7 % "
Total	95,568	73,039	30·8 % increase.

A considerable increase in the number of young bulls has taken place during the last 10 years. In 1914, 72 per cent. of the bulls were under 2 years; in 1909, 67 per cent.; and in 1893, 57 per cent.

Bullocks.—With the advent of dairying the number of bullocks diminished rapidly; in 1898 it dropped to 34,183. In 1914 their number was double that of 1898, but in spite of this there were only 28 bullocks in every 1,000 head of Danish cattle on the 15th July, 1914. The following table shows the ages of the bullocks in 1909 and 1914:—

Age.	1914.	1909.	Remarks.
From 1 to 2 years	49,140	—	—
2 years and over	19,332	—	—
Total	68,472	58,219	17·6 % increase.

Sheep.—During the last 50 years the number of sheep in Denmark has steadily decreased, and in 1914 the number was little more than one-fourth of the total in 1861. The steady diminution is shown in the following figures :—

Year.	*Number.*
1866	1,875,000
1888	1,225,000
1898	1,074,413
1909	726,879
1914	514,022

Of the 514,022 sheep, nearly half were lambs under one year. The total number of lambs weaned betweeu 15th July, 1913, and 15th July, 1914, was 353,000. As the lambs were dropped in spring, it may well be assumed that the majority of them (242,000 lambs) were returned when the census was taken in July, 1914. Of the sheep other than lambs, 21,000 were rams (in 1909 about 28,000), 16,000 wethers and hoggets (in 1909 about 27,000), and the rest ewes that had carried or were carrying lambs (in 1909 about 327,000). The number of flocks of sheep has decreased from 95,000 in 1909 to 71,000 in 1914.

Pigs.—None of the Danish domestic animals shows such fluctuations in numbers as pigs. These fluctuations are mainly occasioned by the ruling price of bacon. The following table gives the figures for the last 21 years, together with the number of pigs per 1,000 acres of land under cultivation and the number per 1,000 of population :—

Year.	Number of Pigs.*	No. per 1,000 acres of tillable land.	No. per 1,000 persons.
1893	829,131	118	372
1898	1,168,493	167	492
1903	1,456,699	208	578
1909	1,467,822	210	543
1914	2,496,661	357	873

* The large number of pigs is directly due to the large quantities of dairy offal (skim milk, whey, etc.) available.

The high prices obtainable for pigs in 1905–07 occasioned a considerable increase in the production. The export of bacon in 1908 exceeded that of any preceding year. A fall in the

price of bacon followed the big exports, accompanied by an advance in the price of corn, and the producers, finding their profits diminished almost to zero, slaughtered their sows in great numbers. Bacon prices improved in 1910, and with a passing fall in 1911 became firm again in 1912 and still firmer in 1913, and in consequence a large increase in the number of pigs was expected in July, 1914. The following table shows the bacon exports and prices* from 1905 to 1914 :—

Year.	Million lb. of bacon exported.	Average price per lb.
		d.
1905	175·9	—
1908	240·0	5·7
1909 .. .	209·4	6·7
1910	213·3	7·4
1911	252·1	6·4
1912	281·0	7·0
1913	278·6	7·8
1914	324·3	—

The census returns in 1914 fully confirmed the expected increase. No fewer than 2,496,661 pigs were found in Denmark on the 15th July, 1914, as compared with 1,467,822 in 1909. The increase during the 5 years was nearly 1,029,000 pigs, or 70 per cent. The increase during the last 21 years was 1,667,530 pigs, or 201 per cent.

As the foregoing figures do not bring out very well the actual state of pig breeding in Denmark the following division of the animals into four groups is essential in order to throw light on this point. The four groups are : breeding animals (boars and sows), bacon pigs, and young pigs :—

Group.	1914.	1909.	Increase.
			Per cent.
Boars from 4 months upwards ..	12,637	7,934	59·3
Sows from 4 months upwards ..	280,629	147,934	89·7
Total number of breeding animals ..	293,266	155,868	88·2
Bacon pigs 4 months old and upwards	707,973	422,439	67·6
Young pigs under four months ..	1,495,422	889,515	68·1
Total number	2,496,661	1,467,822	70·1

Of the four groups, that relating to breeding sows shows the greatest relative increase, viz., 90 per cent. The present position of Danish pig breeding is very favourable for a continuation of the intensive production that has been carried on of late years. It is expected, however, that the scarcity of

* Prices paid to the producer.

feeding stuffs and their high prices since the outbreak of the war will have a retrogressive effect upon Danish pig production.

The number of young farrowed by Danish sows between 15th July, 1913, and 15th July, 1914, was 3,964,000, or 1,413 young per 100 sows (14·13 per sow).

The number of herds of pigs increased between 1909 and 1914 from 188,000 to 208,000, an average increase of 4,000 herds per annum.

Poultry.—It is said that if poultry are intelligently bred and fed they are the most efficient transformers of raw material into finished product on the farm. The following figures prove that Danish farmers are keenly alive to the fact :—

Year.	Total number of fowls and chickens in millions.	Millions of dozens of eggs exported annually.	Average price per dozen paid to producer.	Number of fowls per hundred of population.	Number of fowls per 100 acres of land under cultivation.
1888	4·6	—	—	214	65·7
1893	5·9	10·0	8·4*d.*	265	84·3
1898	8·77	20·2	8·6*d.*	370	125·3
1903	11·56	32·64	9·4*d.*	450	165·1
1909	11·81	29·22	10·0*d.*	437	168·7
1913	15·15	36·0	10·8*d.*	529	216·4
1914	15·15	38·1	—	—	216·4

Since 1881, the number of poultry has been more than trebled. The number of eggs exported in 1914 was nearly four times that exported in 1893. The figures do not include the eggs sent from neighbouring countries to Denmark and re-exported. The price per dozen paid to the producer has improved 31 per cent. in the course of the last 25 years.

In 1909, 41·5 per cent. of the total number of poultry were chickens under 9 months; in 1913, 46·7 per cent. were chickens.

Goats.—Many of the Danish small holders keep goats for their children's sake, owing to the highly nutritive quality of the milk. The following analyses of goat's milk, cow's milk and human milk will make this fact more apparent :—

—	Water.	Solids.	Proteids.	Fats.	Sugar.	Ash.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Average of 43 analyses of cow's milk	87·64	12·36	3·72	3·46	4·42	0·76
Goat's milk ..	87·33	12·67	3·52	3·94	4·39	0·82
Human milk ..	87·02	12·98	2·36	3·94	6·32	0·45

Practically speaking, it may be said that the goat is almost free from tuberculosis, as only about 1 per cent. get the disease, and of these there are extremely few cases in which bacteria are found in the milk.

The following figures indicate the number of Danish goats since 1893 :—

	No. of Goats.		No. of Goats.
1893	25,266	1909	40,257
1898	31,822	1914	40,670
1903	38,984		

Most goat-keepers keep only one goat and few have more than two or three.

Asses are not bred in Denmark.

Statistics of Danish Crops.

In conjunction with the above statistics relating to the live stock in Denmark it may be of interest briefly to consider the other forms of agriculture practised in the country, *i.e.*, the extent to which the principal crops are grown, together with the yields obtained. The total area of Denmark, exclusive of lakes and rivers, is 9,468,000 acres, of which in 1912 woods and plantations, including public parks, occupied 822,458 acres, and crops and grass covered an area of 6,928,817 acres. The following table shows the area under certain crops in 1912 and the production in 1912, 1913 and 1914 :—

Crop.	Area in 1912.	Produce. 1912.	1913.	1914.
	Acres.	Qr.	Qr.	Qr.
Wheat	133,489	434,736	805,102	701,505
Barley	596,280	2,742,743	3,007,584	2,517,165
Oats	1,058,116	5,103,296	5,625,471	4,683,577
Rye	607,091	2,224,036	2,000,776	1,320,480
Mixed Corn, and Corn and Pulse ..	445,470	2,140,071	2,355,677	2,028,862
		Bush.	Bush.	Bush.
Potatoes	151,018	27,806,853	40,650,036	36,203,160
Carrots	19,767	12,323,130	10,940,500	11,169,060
Mangolds	206,870	200,873,563	191,155,599	200,245,290
Kohl-Rabi	253,373	159,223,397	215,850,625	177,577,050
Turnips (and other Fodder Roots) ..	166,750	137,590,719	137,900,575	116,119,710
		Tons.	Tons.	Tons.
Sugar Beet	79,954	970,161	915,054	951,000
		Tons of Hay.	Tons of Hay.	Tons of Hay.
Clovers and Grasses, for Hay	585,867	1,207,833	1,050,066	915,000
Clovers and Grasses, for Pasture ..	1,164,400	—	—	—
Lucerne	[illegible]	—	—	—
Meadows	[illegible]	751,899	717,650	679,000
Permanent Grass ..	256,255	—	—	—

The corn yield in 1914 was 14 per cent. less than the average yield of the foregoing 5 years 1909-13. The yield of roots in 1914 was about 3 per cent. below the average of the five-year period 1909-13.

The annual value of the Danish harvest, *i.e.*, cereals, potatoes, roots, hay, straw, &c., from 1875 to 1911, was as follows :—

Years.	Annual average in millions of £.
1875–78	19·0
1885–87	17·2
1894–96	20·2
1898–02	22·0
1903–07	28·0
1908–11	32·8

——	Average annual yield of the 5 years, 1909–13.	Yield of year 1914.	Proportional figures showing yield in 1914 when average of 1909–13 = 100.
	Qr.	Qr.	
Wheat	660,240	701,505	106
Barley	2,768,194	2,517,165	91
Oats	5,326,624	4,683,577	88
Rye	2,083,882	1,320,480	63
Mixed Corn and Pulse	2,279,891	2,028,862	89
	Bush.	Bush.	
Potatoes	32,159,190	36,203,160	113
Carrots	10,948,980	11,169,060	102
Mangolds	187,728,240	200,245,290	107
Kohl-Rabi	193,697,910	177,577,050	92
Turnips (and other Fodder Roots ..	131,002,620	116,110,710	89

THE COMPOSITION, STORAGE AND APPLICATION OF FARMYARD MANURE.

AN investigation into various problems connected with the making, storage and application of farmyard manure was begun some years ago by the West of Scotland Agricultural College, and although some questions still remain to be dealt with, a report* has been issued on the results so far obtained.

The conditions under which farmyard manure is made and used in the West of Scotland present certain points of special importance: The rainfall is higher than in districts in which the majority of the experiments with farmyard manure have hitherto been carried out (the rainfall at Kilmarnock, where

* West of Scotland Agricultural College, Bull. No. 65. *The Results of some Experiments with Farmyard Manure*, by R. A. Berry, F.I.C.

the present experiments took place, averaged 39·32 in. per annum in the 13 years 1901–13), thus leading to an increased loss by drainage of the soluble manurial constituents ; again, cow manure forms a large proportion of the manure made in the West of Scotland, and the food rations from which it is made vary considerably ; and, further, the soils are generally poor in lime, and the mean summer temperature is lower than that prevailing on the average in Great Britain, these factors possibly affecting the vigour and the types of bacterial flora of the soil, and therefore the decay and rate of exhaustion of the manure in the soil, and consequently the crop yields.

Storage under Cover and in the Field.—The loss in weight in large (8-ton) heaps of freshly-made cow manure between 25th November and 4th April was found to amount, on an average, to 17·5 per cent. when stored under cover, and to 20·6 per cent. when stored in the open. The loss of total nitrogen in manure stored in the open was 28·4 per cent., or 8 per cent. more than the loss in the manure stored under cover. The ammoniacal nitrogen formed the principal source of loss of nitrogen in the manures ; in each case it amounted to over 70 per cent. of that originally present. As regards potash and phosphates, whereas storage in the field resulted in a loss of 21·1 per cent. of the phosphoric acid* and 28·3 per cent. of the potash*, there was practically no loss of these ingredients in the manure stored under cover. Drainage thus accounted entirely for the loss of mineral substances and also for the loss of soluble proteid nitrogen and some ammoniacal nitrogen, but since the loss of the latter substance was much the same under both methods of storage, it is evident that the main loss of ammonia and its compounds must be due to causes other than drainage. The loss due to fermentation was ascertained later (*see* p. 134).

The two kinds of manure were used in the same quantities for potatoes and turnips, and it was found that the average percentage increase of crop resulting from manure stored under cover over the increase from manure stored in the open was 7 per cent.

Storage of Different Kinds of Fresh Manure in Exposed Heaps in the Field.—Five kinds of manures were tested in this experiment, *viz.*, cow, pig, bullock, and horse manure made with straw and horse manure made with peat-moss litter. The average loss in weight of these five kinds, when stored in the

* These large amounts were due to the large proportions soluble in water—*e.g.*, the phosphoric acid was 42 per cent. soluble and the potash 76 per cent. soluble.

open (in 4-ton heaps) from 18th December to 22nd April, was 22·3 per cent. The loss was considerably reduced with peat-moss litter in place of straw. Of the fresh manures, those from fattening bullocks and from horses with peat-moss litter were richest in soluble and available compounds of nitrogen, in phosphoric acid, and in potash soluble in water; next in order were the manures from cows, pigs, and from horses with straw litter. By using peat-moss litter in place of straw litter a larger proportion of urine is absorbed and the fresh manure thereby increased in value.

The average loss of manurial constituents during rotting was:—Total nitrogen, 29·6 per cent.; total phosphoric acid, 12·2 per cent.; total potash, 33·5 per cent.; and organic matter 32 per cent.; the main source of loss of nitrogen being again in the form of ammonia.

A comparison of the composition of the fresh and rotted manures showed the two fresh manures richest in compounds of nitrogen to be left poorest in these compounds after rotting, and *vice versa*, so that it would not appear to be economical to feed cake to enrich the manure, especially in nitrogen, if the manure is to be stored some time before it is used.

The average effect of rotting was, without exception, to lower the value of the manure for manurial purposes, if the value of the manure depends upon its power of supplying available manurial constituents—*e.g.*, the rotted manures contained in the total nitrogen on an average 4 per cent. of ammoniacal nitrogen, and 82 per cent. insoluble compounds, compared with 15 and 72 in the fresh; also, the rotted manure contained 44 per cent. of its phosphoric acid and 71 per cent. of its potash soluble in water, compared with 53 and 76 in the fresh manure.

When equal weights of the rotted manures were applied to a potato and to a turnip crop the increased yield of crop corresponded very closely with the supply of the compounds of nitrogen in the manure, as determined by chemical analysis; and the results of the experiment indicate that, where farmyard manure is used on soils of average fertility, the chemical analysis of the manure, showing the percentage of the different forms of nitrogen, and of the phosphoric acid and potash soluble in water, is a reliable guide to its manurial value.

Treatment of Farmyard Manure during Storage.—The precautionary measures to be taken to prevent undue loss of nitrogen in farmyard manure by *drainage* are fairly obvious, *viz.*: (1) The absorption and retention of as much of the urine

as possible by employing suitable litter; (2) the collection and preservation of the unabsorbed urine in tanks; and (3) the protection of the manure from rain and the leaching action of drainage water; and the experiments were, therefore, practically confined to comparing the methods of preventing undue loss of nitrogen by *fermentation.*

The most effective method found was to trample the manure and to cover it with a 3-in. layer of soil. The conditions causing loss of nitrogen were thus controlled and the loss reduced to a minimum; there was, in addition, an increase in the more available forms of nitrogen. The nearest approach in practice to these conditions is to allow the manure to accumulate in a sodden condition under the feet of the animal, such as occurs in a loose-box, or to draw up the loaded carts on to the top of the manure heap where it is being made in the field.

The least effective method of preventing loss of nitrogen by fermentation was found to be to leave the manure loosely packed; in such conditions the changes resulting in the destruction of organic matter and the breaking down of the complex forms of nitrogen were accelerated. Such conditions commonly occur in practice—*e.g.*, when the manure is carted daily from the byre, piggery, or stable on to a heap without any attempt at consolidating the loosely-packed mass.

Various substances were tried to fix ammonia, and of these gypsum and sodium acid sulphate proved the most efficient, while superphosphate of lime, kainit and carbonate of lime increased the loss of nitrogen Antiseptics were also added to the manure to check fermentation, and of these chloroform acted best, followed by bleaching powder and formalin. The reduction in the loss of nitrogen, where such occurred, was, however, not sufficient in any case to repay the cost of the substance used.

The Time and Method of Application of Farmyard Manure to the Land.—These experiments were carried out with potatoes and turnips in two four-course rotations, *viz.*, potatoes, wheat, seeds and oats, and turnips, barley, seeds and oats. The application of fresh manure (20 tons per acre) broadcast to the soil in the autumn produced an average increased yield of roots of 25 per cent. When the fresh manure was stored until the spring, and the residue of the 20 tons then applied in drills to the root crops, an average increased yield of 42 per cent. was produced, whilst when the manure (20 tons) was applied fresh in drills in spring the average increased yield was 56 per cent. About 9 per cent. of the increase for root crops of

the drilled manures was due to the method of applying the manure in drills over that of broadcasting. In the case of the autumn application of the manure, when the manure was applied to turnips, there was a 5 per cent. increase in favour of ploughing in the manure at once, compared with leaving the manure on the surface some time before ploughing it in ; where the manure was applied to potatoes, however, there was not much to choose between the two practices.

The yield of the root crops from the manure, whether applied in the fresh or rotted state in the spring, coincided with the richness of the manure, as indicated by its chemical composition in the more active compounds of nitrogen.

The manurial residues from farmyard manure were considerably affected according to (*a*) the root crop to which the manure was applied, and (*b*) the time of application of the manure.

The manure applied to potatoes left a residue which produced an increase amounting on an average to 50 per cent. of the total increase produced from the manure by the four crops, including potatoes, in the rotation, whereas the manure applied to turnips left a residue amounting to 34 per cent. of the total increase for the four crops in the rotation. Moreover, the residue in the former case persisted and was not exhausted at the end of the rotation, whereas in the latter case its effect was hardly visible after the second crop.

The residues left from the manures applied in the autumn were, as a rule, distinctly greater than the residues left from the same weight of manure applied in the spring. In the former case the increases due to manure residue amounted, on an average, to 57 per cent. of the total increase produced by the manure, whereas in the latter case they amounted to 34 per cent. of the total increase.

Of the nitrogen supplied in the manure, that recovered in the root crop amounted on an average, for potatoes and turnips, to about 9 per cent. from the autumn applied manure, and to about 18 per cent. from the spring applied manure. For the whole rotation the amount of nitrogen recovered in the crops was not on the average much more than 30 per cent. of that supplied in the manure. Although more nitrogen was taken up by the crop than appeared to be directly available in the manure at the time of its application, considerably more than one-half the nitrogen added in the manure was unaccounted for.

A NEW VARIETY OF HOP— THE "FOUNDLING."

E. S. SALMON, F.L.S.,
Mycologist to the South-Eastern Agricultural College, Wye, Kent.

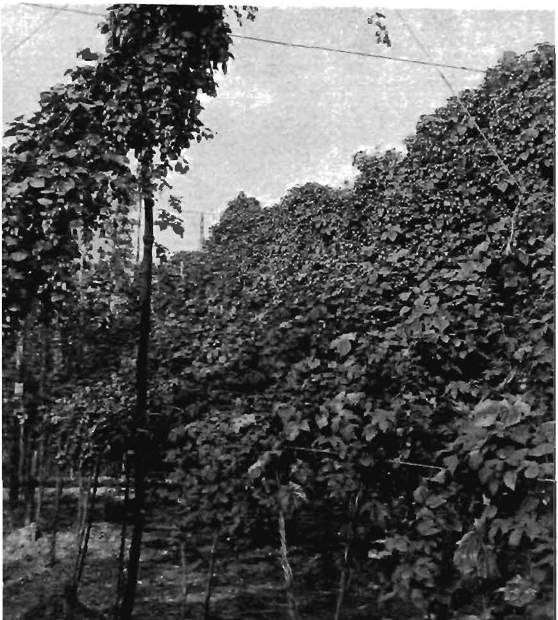
AMONG the hops growing in the Experimental Hop-garden at Wye College, one plant attracted attention in 1906 and 1907 by its vigorous growth and prolific cropping qualities. It was decided to test this hop further; "cuts" were taken from the hill, and in 1908, 38 hills were planted in a row in the main hop-garden at Wye College. From 1908 to 1914 these hills have been under observation, and the following facts appear to be of sufficient commercial importance to merit the attention of hop-growers. As noted below, the hop appears to be distinct from all varieties of cultivated hops, and the writer has given it the name of the "Foundling."*

Disease Resistance.—The hop has proved remarkably resistant to the attacks of the disease popularly known as "nettle-head," "skinkly," or (in Sussex) "silly hill." This disease, which has been attributed to the attacks of an eelworm (*Heterodera schachtii*), is sometimes the cause of serious loss to the hop-grower.

No certain remedy against "nettle-head" is at present known, and it follows, therefore, that the constitutional resistance of a variety of hop to the disease is a matter of importance.

The immunity from, or resistance to, "nettle-head" disease, possessed by the "Foundling" hop became evident under the following circumstances. A row of 38 hills of the "Foundling" was planted, and on either side of this, rows (of a varying number of hills) were planted with "cuts" from hills of other promising varieties in the nursery. The rest of these rows consisted, like the hop-garden generally, of the originally planted hills of the Canterbury White-bine variety. It soon became evident that an attack of "nettle-head" disease was developing in this part of the garden. In 1909, 1 hill, and in 1910, 5 hills near the "Foundling" row were attacked. In 1911, 10 hills were badly affected and had to be grubbed up, 4 of these hills being in the rows adjoining the "Foundling." Notwithstanding the fact that each affected hill was grubbed up as soon as the disease was noticeable, the attack increased in

* The plant, of which only one "hill" existed, was one among a number of different kind of hops of which no record existed as to name or origin.



1.—Photograph of a part of the row of the "Foundling" hop in the hop-garden at the South-Eastern Agricultural College, Wye, Kent.

severity during the next two seasons; in 1912, 28 hills were destroyed, 20 being in the rows adjoining the "Foundling," and in 1913, 44 hills were destroyed, 15 being in the rows adjoining the "Foundling." During 1914 the spread of the disease continued, 43 fresh hills being affected in the various rows. During 1914 a male hop which had been interplanted in 1909 in the row of the "Foundling," and which up to that year had been extremely vigorous, showed in early summer evident signs of the disease, and although the bines managed to reach to the top wire, they were so seriously affected that no flowers were produced. From 1909 to 1914, therefore, 131 out of the 228 hills planted in rows on either side of the "Foundling"—that is to say over 57 per cent. of the hills—have been so badly affected by the disease that they have had to be grubbed up. So much damage, indeed, has been done that the whole of this corner of the hop-garden (with the exception of the "Foundling" row) has had to be grubbed up and replanted.

During this period of 6 years, however, not a single hill of the "Foundling" has been affected, although the row extends through obviously infected ground. This immunity was the more striking in that the roots of the "Foundling" hills were found, on examination, to be infested by the "eelworm" in large numbers.

With regard to resistance to other diseases, it would appear that the "Foundling" is not liable to severe infestations of "blight" (*Aphis*); it is, however, about as susceptible to "mould" (*Sphærotheca humuli*) as most varieties of hops.

General Characteristics.—The growth is very vigorous; the bine is green, with blotches (often inconspicuous) of dark green or red, and is very fruitful. It is a late hop, ripening about ten days later than the Canterbury White-bine. In the medium hop soil of the College hop-garden the crop in an average season is about 15 cwt. to the acre; in 1914 the hills yielded at the rate of 22 cwt. to the acre. In richer hop soil at Chilham, Kent, 3 older hills and 22 hills in their second year bore in 1914 at the rate of 18 cwt. to the acre. The hops are small to medium in size, and hang very thickly on the laterals. Photographs of a part of the "Foundling" row in the College hop-garden, and also of separate hops, are shown in Figs. 1, 2, 4, and 5. In some respects the "Foundling" hop resembles the Colgate variety, though it is clearly quite distinct. Its distinguishing characters can be seen on referring to Figs. 3 and 6, which show the Colgate hop.

Flavour.—The reports of hop factors, hop merchants and brewers as to flavour and "rub" on samples (unnamed) of the "Foundling" hop submitted in 1907, and each season since 1910, have been as follows:—

1907. (Box sample.) "Good flavour" (Factor E).*

1910. 20 bushels of hops were picked from 35 hills planted with "cuts" in 1908–9; they were dried separately on the oast and put into a pocket. An ordinary commercial sample was cut from the pocket, and was reported on as follows:—"Comes below Canterbury White-bine; lacks refinement and has ranker flavour; has more 'rub' than a Cobb's Golding, and is decidedly superior to that" (Factor A); "is not a Golding; has rank flavour, which is the Colgate flavour pure and simple; should not be grown" (Factor B); "*of full flavour, not rank*—worth going on with" (Merchant D).

1911. 40½ bushels of hops were picked from 35 hills, dried separately and put into a pocket. An ordinary commercial sample was reported on as follows:—"Is not a true Colgate, but has a ranker flavour—probably belongs to the Colgate class" (Factor A); "a very nice flavour, inclined to the Colgate—a good hop" (Factor B); "has strong but *not coarse* flavour" (Merchant D).

1912. (Box sample.) "Quite good, mild flavour" (Factor A).

1913. (Box sample.) "Very nice flavour; should say was as good a hop as Fuggles" (Factor A); "poor in colour; good mild flavour; fair 'rub'" (Merchant D).

1914. Four samples were submitted from the following sources:—(1) Wye College hop-garden; commercial sample cut from pocket; (2) Wye College hop-garden; box sample; (3) Chilham, Kent (strong loam of some depth over chalk); box sample; (4) Midhurst, Sussex ("malm rock," *i.e.*, Upper Greensand); box sample (unpressed). The reports obtained were as follows:—Factor A reported: "In all the samples I detected the same flavour, which I should call rank, or even as having a certain 'rancidity'; (1), (2) and (3) I should class as equal; (4) has ultimately, deep down, the same flavour, but its aroma comes quicker; I should say the characteristic flavour of this hop is more developed in the Midhurst soil, while in the Kent soils it is more subdued." Factor B reported: "(1), (2) and (3) have all the same flavour, which is mild; an inferior hop; (4) a much stronger flavour and a better hop; it could not be recognised as the same hop as in (1), (2), (3)."

Brewing trials of the hop were made in 1910 and 1911 at two different breweries. The first brewery reported that the results in a bitter beer were not quite satisfactory; it was suggested that the hops would no doubt be suitable for lager

* The same letter designates the same judge in the different seasons.

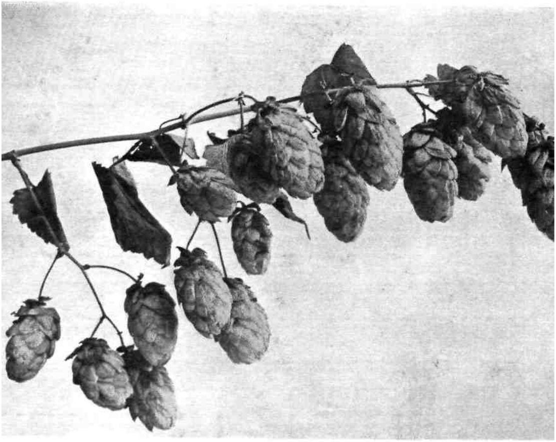
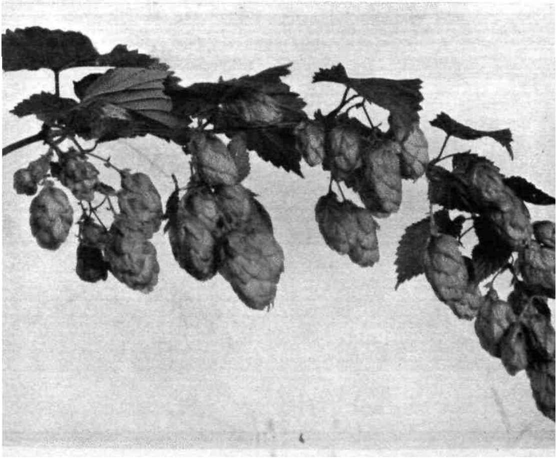


FIG. 2.—A branch of the "Foundling" hop.



beer; and the opinion was expressed that if this variety of hop possessed good cropping qualities it would, on account of its richness in resins, be worth growing. The second brewery reported that the hops, on chemical analysis, proved second in percentage of resins of all the samples of hops tested that year at the brewery, and that, therefore, they could be considered quite up to the average of the year's hops in preservative value; further, that though not a bright-looking sample, the hops were well grown out and of a thick appearance. In the brewing trials the flavour was not considered delicate enough for pale ale, but the opinion was expressed that the hop might be useful to replace foreign hops in those breweries where the latter are used. The opinion of a third brewery on the four samples of 1914 was as follows :—" None gives the old Golding flavour—in fact, we think them all tainted more or less with the Oregon aroma. We prefer (1) and (2), and think that (1) has the most delicate and truer hop flavour; we consider (3) has a considerable vegetable aroma, and condemn it; (4) is the rankest and not suitable for the best light ales. We are quite satisfied with (1) and (2) for ordinary running beers."

Resin Production.—Chemical analyses, using the Bryant and Meacham process (slightly modified),* to ascertain the percentage of soft resins, have been made during the past four seasons of samples of the "Foundling" growing in the College hop-garden. The figures are as follows :—

		A, per cent.	B, per cent.	Average, per cent.
1910	—	10·51	8·98	9·75
1911	—	9·78	10·48	10·13
1913	—	11·40	12·74	12·07
1914	Sample (1) ..	12·44	11·49	11·96
"	" (2) ..	11·44	10·99	11·21
"	" (3) ..	9·84	10·92	10·38
"	" (4) ..	11·08	11·92	11·50

Reviewing the above data as to the brewing value of the "Foundling," it seems clear that it does not possess the true "Golding" flavour, and that it is not suitable for the best pale ales. In those cases, therefore, where the hop-grower finds it more profitable to grow only those varieties of hops which possess the delicate "Golding" flavour, it would not be advisable to plant the "Foundling." Where, however, such is not the case, it would seem that the "Foundling" is

* See *Journal of the South-Eastern Agricultural College* (Wye), Vol. XIX., (1910) p. 375.

worthy of a trial by the commercial hop-grower, since, as regards flavour, it appears to be suitable for some kinds of beer, and possibly for lager. With regard to resin production, if 10 per cent. of soft resins be taken as indicating a satisfactory hop, the "Foundling" stands above the average, and may claim, therefore, to be a powerful "copper" hop.

Summary.—The "Foundling" seems worthy of trial by the commercial hop-grower on account of the following characteristics :—

(*a*) Good cropping qualities.
(*b*) High resin production.
(*c*) Marked resistance to, if not total immunity from, the "nettle-head" disease.
(*d*) Lateness of season (coming after the "Fuggles").

Hop-growers in Kent, Surrey or Sussex can obtain 25 "cuts" of the "Foundling," free of charge, on application before November in any year to the Secretary, S. E. Agricultural College, Wye, Kent. Hop-growers in other counties can obtain sets from those farmers in Kent, Surrey or Sussex who are already growing the "Foundling," a list of whom will be forwarded on application to the College.

RABBIT BREEDING ON SMALL HOLDINGS.*

P. E. WILSON.

In order to derive the best possible results from table-rabbit farming, it is important that, in addition to selecting the right breed, the rabbits should be housed in a satisfactory manner. In the case of the small breeder live stock is too often kept in very insanitary surroundings; rabbits are special sufferers in this respect, and are often found stowed away in dark and foul-smelling boxes. However limited the available space may be, there is no excuse for this state of affairs, and the importance of keeping rabbits in healthy surroundings cannot be too strongly urged upon the small holder.

Systems of Housing.—There are two main systems of housing rabbits, *viz.*, (1) in stack hutches, and (2) in movable hutches.

* The information given in this article is supplementary to that contained in the article on "Utility Rabbit Breeding for Small Holders," published in this *Journal* for March, 1911, p. 982.

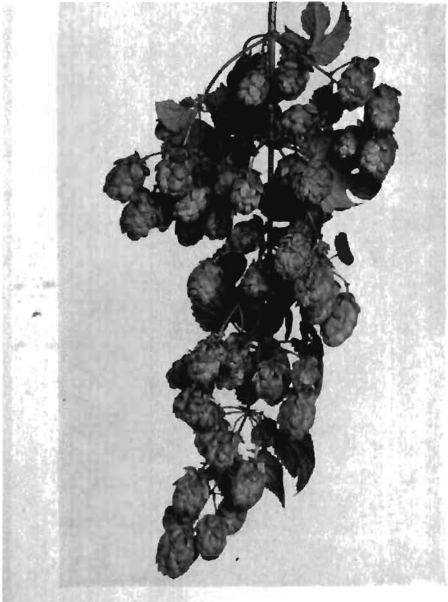


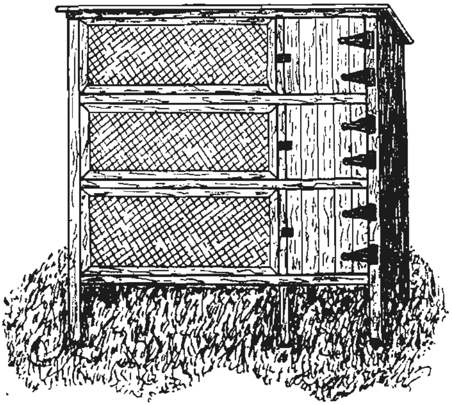
FIG. 4.—A branch of the "Foundling" hop.

FIG. 5.—Hops, the "Foundling."

FIG. 6.—Hops, the "Colgate."

For all-round use the first-named kind of hutch is undoubtedly superior, and is recommended, for reasons that are mentioned below.

The old fashioned stand hutches were often very ponderous structures, difficult to clean, and taking up a great deal of room. This class of hutch is now obsolete, and the type known as the stack hutch has completely taken its place. The stack hutch may be regarded as the standard modern hutch, as it is more than likely that any further improvements will be merely modifications and adaptations of the same principle.



The Stack Rabbit Hutch.

Briefly, the stack hutch is an arrangement of three or four tiers of hutches placed one over the other. The advantages of stack hutches are as follows:—(1) They take up very little room; (2) they provide ample light and abundant ventilation; (3) they are labour-saving, since all the rabbits are more or less together in one spot; and (4) they are economical in construction, the floor of the second hutch serving as the roof, or top, of the one underneath. It will also be apparent that, by reason of the design, they are economical in material.

A very common mistake that is made by a great many rabbit breeders is to make use of hutches of inadequate size. Of

course, the size must depend to a certain extent on the breed of rabbit, and the purpose for which it is kept, but for the utility breeder, who keeps the largest breeds of rabbit, hutches of adequate size are essential. Suitable measurements are as follows :—Total length of each hutch 6 ft., from which a space 1 ft. 6 in. should be boarded off (leaving a door in the partition for the rabbit to go in and out at will) to serve as the nesting compartment ; height 2 ft., width 2 ft.

It will be noticed that the hutches are comparatively narrow, but the width suggested gives ample space, owing to the length, and it will be found far better to have a hutch 6 ft. by 2 ft. than one more nearly approaching a square.

The actual number of tiers in a stack is more or less a matter of taste, but, for general use, three will usually be found the most convenient, the lowest being raised off the ground a little. As each hutch will be 2 ft., the whole stack will be about 6 ft. high. If these hutches are to be used in the open air, the roof must slope from front to back, to allow a proper fall during wet weather.

The small holder may either buy his hutches ready-made, or make them himself. The choice is largely a matter for his own consideration, and must depend upon the facilities at hand for obtaining the necessary materials at a moderate cost, and also upon his own skill as a rough carpenter.

A really good practical hutch at a moderate figure can be purchased ready for use ; the style and measurements are similar to those just described, and the illustration on p. 141, showing a stack of three hutches, will give the reader an idea of its appearance. These hutches are made in stacks of three and six hutches, and if they are built in sections to facilitate transit, they can be easily re-erected on arrival.

As regards the construction of hutches on the small holding itself, Mr. H. G. Read, a member of the Committee of Management of the British Table Rabbit Association, makes the following interesting observations :—

" I find small holders and farmers are usually handy with their tools, and utilise such spare wood or boxes as they can get cheap locally. They want no instructions in detail, only the suggestions of style, etc. The cheapest and easiest way is probably to make three wide shelves right across a stable or shed, build in a framework in front, and then make movable wire fronts and wooden partitions. One thus gets two rows of hutches. The fronts are fastened in with buttons, or better still by small pieces of wood dropping over the front."

This is a simple way of making a stack of hutches, which will doubtless appeal to many. The wire netting door of the run, and the wooden door of the nesting compartment could be hung in the usual manner with hinges, if preferred. The wire doors (covered with 1 in. wire netting) can be hung at the top, side, or bottom as preferred; the wooden doors are hung at the side.

There is, of course, a wide difference of opinion as to the respective merits of housing the rabbits under cover or in the open air. It is difficult to give a definite opinion on the subject, though the writer prefers the indoor system, provided that the stock are well housed, and are kept clean and healthy. In a good shed or building, breeding can proceed regularly throughout the year; in stormy weather, and on dark nights and mornings, it is obviously more comfortable to attend to small stock under cover; and, in addition, the warmth and shelter of a building naturally favour fattening. Taking these several points into consideration, it would appear that the indoor method is the superior.

In building hutches, the framework and boarding should be as strong and well-seasoned as possible, and this, of course, specially applies to outdoor rabbit farming, where the hutches have to withstand our very variable climate. For outdoor use, the sloping roof, previously mentioned, should be covered with tar felting.

A substantial hutch can be made by using a strong deal framework 1½ in. to 2 in. thick, and the same width, and ¾ in. tongued and grooved boarding. The wooden framework for the wire netting doors should be composed of 2 in. by 1 in. deal framing, firmly mortised and tenoned. It must be remembered that there is a great deal of wear and tear on the doors, so that it pays to have them really well made at the outset. Good materials will save a constant series of repairs, and, though more costly at the start, the small holder will find them far cheaper in the long run.

In the Movable Hutch System the rabbits are kept on the ground, and out of doors. The hutches should be 6 ft. long, 2 ft. wide, and 1 ft. 8 in. high in front, the roof sloping slightly to the back. The floor consists of 1¼-in. wire netting, and at one end there is a raised wooden floor 1 ft. 6 in. long for the nesting compartment. The front of the hutch is half wire netting and half wood, and to provide protection there is a sliding wooden shutter running between a rail at the top and bottom of the hutch. The door is in the roof, and should

be of good size, to allow plenty of room for cleaning the inside of the hutch and for feeding. These hutches are only suitable where there is grass land. The herbage, of course, protrudes through the wire netting floor, so that the rabbits can readily crop it. They may (provided it is not wet weather) be moved to a fresh patch, morning and evening, and, in this manner, they get practically all their own green food; hand feeding must, of course, be carried out in the usual way.

The system is not to be recommended to anyone to take up extensively, as it is not satisfactory in winter. At the same time, during the spring and summer months, it is not a bad plan to have a few hutches to work over a grass orchard or piece of rough grazing land. The droppings from the rabbits have a beneficial effect on grass land, and increased crops will follow in places where rabbits have been kept on this system. It might assist many small holders to have a number of these hutches in use during the summer months, as they could then breed more stock.

It is really impossible to give any satisfactory details of cost where home-made hutches are concerned, as so much must depend on individual circumstances, and on the material available.

Rabbits should be bedded down on hay or straw. The small holder will probably be in a position to utilise rough grass (made into hay) for the purpose. It may be assumed that the value of the manure is a set-off against the cost of the litter, the manure being very much more valuable as a fertiliser than is often supposed.

If available, sawdust should be used liberally, as there is nothing better for soaking up the urine, and generally keeping the hutches in a wholesome condition. Sawdust should also be put underneath the litter in the nesting compartment. Failing sawdust, sand, sifted ashes, or dry earth may be utilised.

For cleaning out hutches, few implements are required; in fact, with the exception of a shovel and yard broom, all that is wanted is a metal scraper, a handbrush for sweeping out the floors, and a small shovel for the sawdust or other absorbent. The first consists of a metal handle and a crosspiece at the end about 2½ in. in width. The best brush is the ordinary hand banister brush, and for the sawdust an ordinary small coal scoop is sufficient.

Fattening Stock.—When weaned, the young rabbits may be moved for fattening into one of the ordinary stack hutches, or a greater number can be run together in larger and specially

constructed pens, either on the same principle, or on the ground, in a shed or other building. It is not desirable to keep a great number together; the best results are obtainable by transferring the young rabbits to pens made on the ordinary stack principle, but these could, of course, be made larger, in order to accommodate, say, 10-12 in each pen. The nesting compartments could be dispensed with. Some breeders obtain very good results by running a batch of young rabbits together in loose boxes, but care must be taken to exclude draughts and to avoid damp.

Selection of Utensils.—With regard to feeding utensils, there is probably nothing better than glazed pottery, but this is far too dear when saucers and troughs are required in numbers, and as a substitute red flower-pot saucers are very clean and satisfactory. For single rabbits a saucer of 7 in. diameter is advocated, but for a number of rabbits together saucers of 10 in. to 12 in. diameter should be used. Drinking water can be given in the same class of vessels. These saucers are sold by the "cast," the number of saucers in a "cast" varying with their size. For instance, there are 24 to a cast in the 7-in. size, but only 4 to a cast in the 12-in. size. The cost is about 2*s.* to 2*s.* 3*d.* per cast.

The utensils required for killing and dressing the rabbits may consist of the following:—A sharp-pointed "sticking" knife, a larger knife for dressing, a steel, a pair of scissors, two pails, a few cloths, a number of wooden skewers for ventilating the carcasses when dressed, and a selection of hooks to hang the rabbits on after the operation. To this list, however, must be added the highly important spring balance for weighing the carcasses. The killing knives can be procured at any shop making a speciality of butcher's implements.

Foods and Feeding.—With regard to the cost of feeding the small holder should—as a general rule—be in a good position for obtaining green food, as, apart from the common weeds that will probably be found on the holding, *viz.*, dandelions, plantains, hogweed, groundsel, charlock, dock, sow-thistles, cow-parsley, yarrow (all of which rabbits devour greedily), he will have available a large quantity of waste produce from market garden crops, cabbages, lettuces, turnips, carrots, etc., and, in addition, he will probably grow a certain amount of green food, such as mixed clovers and grasses, vetches, or rape.

The meals and grain required for feeding are not likely to be purchased specially for the rabbits, but will be bought in bulk for the use of other stock; these foods include bran, middlings, barley meal, and oats. It is obvious that the rabbit keeper who has available a plentiful supply of green food, and can buy his feeding stuffs in bulk, is in an advantageous position.

If rabbit breeding is carried on intelligently, and if due attention is given to the selection of stock, the system of housing, and the provision of a suitable and economic food supply, there is little doubt that it will prove profitable.

It is somewhat difficult to obtain statements of accounts which have been accurately kept dealing exclusively with the production of table rabbits by the small holder, but it may be useful to give some rough indication of the financial aspects of production. The approximate cost of raising a rabbit to killing age under ordinary circumstances may be put at 10*d.* Assuming that the average rabbit scales 2¾ lb. dressed weight, and sells at 6*d.* per lb., the selling price would be 1*s.* 4½*d.*, and the gross profit would be 6½*d.* These figures are only approximate, and must be used with the reserve necessary in such cases. A small holder can materially increase his returns by keeping his stock pure, and selling a proportion of the most promising rabbits for breeding purposes.

The Waste from Saw-Mills as a Source of Potash.

THE following note has been communicated to the Board by Mr. C. T. Gimingham, F.I.C., University of Bristol, Agricultural and Horticultural Research Station:—Since the outbreak of war various methods have been suggested for making up, to some extent, the deficiency in our supplies of potash manures caused by the cessation of the imports from Germany. Reference may be made in this connection to recent work on the value of the ashes from hedge-clippings, &c.,* and from waste forest produce.†

In addition to the potash obtainable from these sources there is a very large amount of material, of which little use is made, in the wood-scraps, saw-dust, and shavings from planing machines, &c., produced in enormous quantities in every saw-mill in the country. It is true that some of the

* E. J. Russell, *Jour. Bd. Agric.*, Vol. XXI., No. 8, November, 1914.
† See Leaflet No. 25, Board of Agriculture for Scotland.

wood-waste, in particular the saw-dust, is saleable as such in certain localities, and it is also true that the percentage of ash in the shavings and saw-dust, especially from some of the imported timbers, is very small. Even when allowance has been made for both these considerations, however, it remains a notable fact that there are vast quantities of wood available for conversion into ash.

1. In many saw-mills the wood-waste is already used as fuel, and the ash obtained usually either accumulates in a heap, and incidentally loses nearly all its potash by exposure to rain, or it is given away to anyone who will take it. In some few cases it is sold to a neighbouring farmer at a low price.

The writer has recently examined a number of samples of such ash. Some consisted of comparatively coarse material obtained from gas-producing plants, etc.; others were flue-dusts from boiler flues and chimneys. Flue-dust is the more valuable material, sometimes containing up to 10 per cent. of potash, constituting a manure of about the same value as kainit; it is always obtained perfectly dry, and is in a beautifully fine mechanical condition. The percentage of potash in a few of the samples was as follows :—

	Potash (K_2O). Per Cent.
Sample No. 4—Coarse Ash : combustion very complete ..	7·24
,, 5— ,, ...	5·08
,, 6—Flue-dust	9·11
,, 8— ,, ...	6·35
,, 9— ,, coarser than Nos. 6 and 8 ..	5·89
Average	6·73

2. In other mills a mixture of wood and coal is burned. If wood-ash were a saleable commodity, however, it would in many mills be possible to increase the use of wood in the furnaces.

3. In mills where the wood-waste is not used as fuel the quantity produced is often so great that its disposal is a matter of serious difficulty. Were there a demand for wood-ash, there is little doubt that many firms would find it worth while to install plants adapted to use wood as fuel either for steam-raising or gas-making. Moreover, in big towns where there are many large saw-mills turning out hundreds of tons of wood-waste every week, it might very well pay to set up special plant for burning the waste for the express purpose of ash production.

In view of these considerations it would seem useful to bring to the notice of both farmers and timber merchants the possibility of utilising wood-ashes, at least in their own localities, in place of kainit when potash manuring is contemplated. If even a small general demand sprang up and the collection of the material could be satisfactorily organised, it is possible that a considerable trade could be done.

With regard to the value of wood-ash and flue-dust obtained from saw-mill furnaces, it is important to remember that since timber is relatively poorer in potash than leaves, bark, twigs, etc., the material will, in the great majority of cases, contain less potash than similar ash obtained by burning the undergrowth and waste of forest and woodland. It will, therefore, constitute a somewhat cheaper and lower grade fertiliser. On the basis of the ordinary price of kainit, ashes, such as those of which the analyses are given, should be worth from 25*s.* to 50*s.* per ton; and since ash is almost purely a waste product, there is good reason to suppose that it could compete with kainit even in normal times.

Notes on Feeding Stuffs in May: From the Animal *Nutrition Institute*, Cambridge University.

THE table on p. 150 gives the prices per ton and per food unit of 33 feeding stuffs at London, Liverpool, Hull, and Bristol. The feeding stuffs are in general the same as those included in the lists already published in this *Journal** with descriptions and suggestions for use, to which reference should be made.

In the list given on p. 149 the feeding stuffs are arranged in order of price per food unit. Price per ton is not a reliable indication of the value of a feeding stuff. The true value of a feeding stuff depends on the amount of nutritive material which it contains as well as on the price per ton. In order to assess the value the price per food unit is calculated as follows: The percentages of digestible protein and fat are multiplied by $2\frac{1}{4}$, and added to the percentage of digestible carbohydrates. The sum gives the number of food units in 1 ton. By dividing the price per ton by this figure the price per food unit is obtained, and the price per food unit is a good index of relative value. Foods, however, should not be bought entirely according to their price per food unit, which takes no account of their suitability for special purposes. For instance, wet brewers' grains are at

* March, 1915, p. 1111; April, 1915, p. 52.

present the cheapest feeding stuff per food unit, but although they are excellent for some purposes they would not be a suitable food for stock turned out to grass. In selecting feeding stuffs from the list, therefore, it is necessary to choose

	s.	d.	
Brewers' grains (wet) ..	1	0¼	per food unit.
Soya bean cake	1	3¼	" "
Coconut cake	1	4½	" "
Maize gluten feed	1	4¾	" "
Palm-nut kernel cake ..	1	6	" "
Malt culms	1	6¼	" "
Decorticated cotton cake ..	1	6½	" "
Linseed cake, Indian ..	1	6¾	" "
Brewers' grains (dry) ..	1	7½	" "
Linseed cake, English ..	1	8	" "
Wheat pollards	1	8	" "
Wheat middlings	1	8	" "
Wheat bran	1	9¼	" "
Maize germ meal	1	9½	" "
Distillery grains (dried) ..	1	9½	" "
Cotton cake, Egyptian ..	1	9½	" "
Rice meal, Burmese ..	1	10	" "
Cotton cake, Bombay ..	1	10¼	" "
Wheat sharps	1	10½	" "
Peas, English dun	1	11	" "
Beans, English	1	11	" "
Wheat bran, broad	1	11½	" "
Maize, Argentine	1	11¾	" "
Maize, American	1	11¾	" "
Beans, Chinese	2	0¼	" "
Maize meal	2	2¼	" "
Barley, English feeding ..	2	2¾	" "
Peas, English maple ..	2	4¼	" "
Peas, Calcutta white ..	2	11¼	" "
Oats, Argentine	2	11½	" "
Oats, English	3	1½	" "

not that which is absolutely the cheapest, but the cheapest which is suitable for the purpose in view. This principle has been used in compiling the following rations :—

For Horses at Farm Work :—

4 lb. Sharps.
2 „ Maize, crushed.
1 „ Bean Meal.

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate price per ton at the beginning of May.				Approximate price per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya Bean Cake	1 : 1·1	122·3	—	8 5 0	7 10 0	7 17 6	—	1 4	1 2¾	1 3¼
Decorticated Cotton Cake	1 : 1·3	126·3	9 10 0	10 0 0	—	—	1 6	1 7	—	—
Indian Linseed Cake	1 : 1·9	123·1	9 15 0	9 15 0	—	—	1 7	1 7	1 6	—
English Linseed Cake	1 : 2·0	120·1	9 17 6	10 12 6	9 5 0	9 12 6	1 7¾	1 9¼	—	1 7¼
Bombay Cotton Cake	1 : 2·4	65·3	5 18 9	6 5 0	6 2 6	6 0 0	1 10	1 11	1 10¼	1 10
Egyptian Cotton Cake	1 : 2·0	71·9	6 5 0	6 15 0	6 10 0	6 7 6	1 9	1 10½	1 9¾	1 9¼
Coconut Cake	1 : 3·8	102·6	6 17 6	—	—	7 10 0	1 3½	—	—	1 5½
Palm-nut Kernel Cake	1 : 4·0	83·5	6 12 6	5 12 6	—	6 10 0	1 7	1 4¼	—	1 6¾
English Beans	1 : 2·6	99·5	9 1 1	10 5 4	9 14 0	9 5 3	1 10	2 0¾	1 11½	1 10½
Chinese Beans	1 : 2·6	101·2	10 0 8	10 14 8	10 3 0	—	1 11½	2 1½	2 0	—
English Maple Peas	1 : 3·2	97·2	11 2 3	—	11 16 0	—	2 3¼	—	2 5¼	—
English Dun Peas	1 : 3·2	97·2	9 17 4	—	8 17 6	—	2 0¼	—	1 10	—
Calcutta White Peas	1 : 2·3	97·5	14 4 5	14 11 2	—	—	2 10½	3 0	—	—
American Maize	1 : 11	93·8	8 17 4	9 10 5	—	—	1 11	2 0½	—	—
Argentine Maize	1 : 11	94·2	9 2 0	9 6 8	9 4 4	9 11 4	1 11½	1 11¾	1 11½	2 0¼
Maize Meal	1 : 13	86·4	9 0 0	9 15 0	9 10 0	9 15 0	2 1	2 3	2 2¼	2 3
Maize Gluten Feed	1 : 3·3	121·6	8 7 6	—	—	8 10 0	1 4½	—	—	1 5
Maize Germ Meal	1 : 8·4	99·2	8 15 0	8 12 6	9 0 0	9 0 0	1 9¼	1 8¾	1 9¾	1 9¾
English Feeding Barley	1 : 7·8	83·0	9 0 0	—	9 5 6	—	2 2	—	2 3	—
English Oats	1 : 7·9	75·4	12 0 0	11 13 0	11 13 4	12 0 0	3 2¼	3 1	3 1¼	3 2¼
Argentine Oats	1 : 7·9	73·4	11 12 1	10 16 0	11 12 0	10 13 8	3 1	2 10¼	3 1	2 10
Malt Culms	1 : 3·6	69·9	—	—	5 0 0	5 12 6	—	—	1 5¼	1 7¼
Brewers' Grains (dried)	1 : 5·4	84·5	7 0 0	—	6 10 0	6 17 6	1 8½	—	1 6½	1 7½
Brewers' Grains (wet)	1 : 3·4	21·1	1 5 0	—	0 18 0	—	1 2¼	—	0 10¼	—
Distillery Grains (dried)	1 : 3·5	77·8	7 5 0	—	—	—	1 9¼	—	—	—
Porter Grains (wet)	no analysis.		1 2 6	—	—	—	—	—	—	—
Egyptian Rice Meal	1 : 10·3	78·7	—	—	—	—	—	—	—	—
Burmese Rice Meal	1 : 10·3	78·7	7 5 0	7 0 0	—	7 5 0	1 10¼	1 9¼	—	1 10¼
Wheat Middlings	1 : 5·3	95·4	8 0 0	—	7 10 0	—	1 8½	—	1 7¼	—
Wheat Sharps	1 : 5·3	86·3	8 2 6	8 2 6	8 5 0	8 0 0	1 10½	1 10½	1 11	1 10¼
Wheat Pollards	1 : 5·3	81·9	—	6 17 6	—	—	—	1 8	—	—
Wheat Bran	1 : 5·3	77·5	6 15 0	6 17 6	7 0 0	7 0 0	1 9	1 9¼	1 9¾	1 9¼
Wheat Bran (broad)	1 : 4·7	79·9	7 10 0	7 12 6	8 10 0	7 12 6	1 10½	1 11	2 1½	1 11

This should be mixed with damped hay chaff. It is understood that the horses will also get the usual allowance of long hay, which will, as the season advances, be gradually replaced by green fodder. The ration of meal may be increased up to 10 lb. per head per day if the horses are very hard worked, or if the green fodder is not leguminous. It may also be advisable to increase the ration for very large horses.

For Cattle finishing for Beef on Roots or Green Fodder.—Ration per 1,000 lb. live weight per day :—

6 lb. Linseed Cake.
3 ,, Bean Meal.

If roots or green fodder are scarce, and can only be used in smaller quantities than usual, 2 to 4 lb. of rice meal may be added to the ration to take the place of the sugar in the roots.

For Cows turned out to Grass.—Ration per 1,000 lb. live weight, for a daily milk yield of about 2½ gallons :—

3 lb. Cotton Cake.

For very heavy milkers 1 to 3 lb. of coconut cake may be given in addition to the cotton cake. As soon as the grass no longer scours the cows, the cotton cake may be replaced by an equal quantity of coconut cake, which is much cheaper per food unit, but which lacks the binding properties of cotton cake.

For Calves for Baby Beef at Grass.—Ration per 250 lb. live weight :—

1 lb. Linseed Cake.
1 ,, Bran.

This should be fed dry mixed with about a pound of hay chop. If the grass is poor, 1 lb. of bean meal may be added to the ration, and the hay chop may be increased to 1½ lb.

For Heifer Calves and Store Steers at Grass.—Ration per 250 lb. live weight :—

½ lb. Linseed Cake.
1 ,, Bran.

This should be fed dry mixed with 1 lb. of hay chop. If the grass is poor the linseed cake may be increased to 1 lb.

For Ewes suckling Single Lambs on the Fold.—Ration per 150 lb. live weight :—

½ lb. Cotton Cake.

For Ewes suckling Twin Lambs on the Fold.—Ration per 150 lb. live weight :—

½ lb. Cotton Cake.
¼ ,, Dried Brewers' Grains.
¾ ,, Hay Chop.

For Lambs with Ewes as above to come out fat.—Ration per 75 lb. live weight :—

$\frac{1}{4}$ lb. Linseed Cake.
$\frac{1}{4}$,, Bean Meal.
$\frac{1}{8}$,, Bran.
$\frac{1}{8}$,, Malt Culms.

This should be fed in troughs through "creeps," mixed with $\frac{1}{4}$ lb. seeds hay chop.

For Store Lambs.—Half the above ration.

For Ewes at Grass suckling Single Lambs.—$\frac{1}{2}$ lb. Whole Beans. If suckling doubles increase to $\frac{3}{4}$ lb.

For Lambs to come out fat off Grass.—

$\frac{1}{4}$ lb. Linseed Cake.
$\frac{1}{8}$,, Bean Meal.

This should be fed in troughs behind "creeps."

For Pigs.—

Growing Stores.—Sharps, amount according to weight of pigs.

Fattening Pigs.—

$\frac{1}{2}$ part by weight	Sharps	Amount according to weight of pigs.
$\frac{1}{3}$,, ,,	Rice Meal	
$\frac{1}{6}$,, ,,	Bean Meal	

Suckling Sows.—

$\frac{1}{2}$ part by weight	Sharps	Amount according to weight of pigs.
$\frac{1}{3}$,, ,,	Bean Meal	
$\frac{1}{6}$,, ,,	Rice Meal	

The Use of Forage Crops for Pig-Feeding.

IN view of the importance at the present time of maintaining and, if possible, increasing the stock of pigs in this country, it is desirable that, pending the usual autumn supplies of waste potatoes, "tail" corn and similar farm by-products, increased attention should be paid to the production of cheap summer feed suitable for pigs. In this connection the practice of growing forage crops for consumption by pigs, common enough in some countries, is capable of considerable extension in this country. It is not claimed that green food alone will do more than maintain the condition of pigs, but it will effect a considerable saving of meal and furnish excellent supplementary feeding during the earlier stages of fattening. It is necessary, however, that pigs should be allowed gradually to accustom themselves to this class of food. Happily the range of crops to choose from and the methods of utilisation are sufficiently varied to suit the circumstances of most pig-keepers. Forage crops may be utilised in the following ways :—

(1) folding or pasturing,
(2) soiling.

Folding or Pasturing.—Rape, red clover and lucerne are among the most suitable crops to grow for this purpose. Rape should be sown at the rate of about 3 lb. per acre in rows about 28 inches apart—at short intervals for sectional grazing—and should not be thinned, as it is desirable to prevent the formation of coarse stems. The pigs should be turned on when the crop is about 12 in. high. If not too closely grazed a second crop may be obtained in a favourable season. The rows serve the double purpose of obviating trampling and facilitating cultivation in preparation for a second growth. For sectional grazing hurdles or movable fencing will usually be found the most suitable means of confinement.

Red Clover (Leaflet No. 184) and Lucerne (Leaflet No. 160) may likewise be fed in sections, or, if circumstances permit, the pigs may be allowed to graze at large over the fields. Except, however, in the case of brood sows in the early months of pregnancy, and gilts to be used for breeding, facilities for extensive roaming are not desirable. Where shade and shelter are not available naturally, these must be provided.

It is estimated that an acre of rape or lucerne will keep from 12 to 20 pigs of 100 lb. live weight for 4 weeks, while 1 acre of red clover or lucerne will provide grazing for 10 such pigs throughout the season. A good "stand" of lucerne will probably keep more. It is, however, advisable not to

overstock lucerne but to mow the crop from time to time so as to encourage fresh succulent growth. Lucerne might often be grown in orchards, for pig pasture, with advantage both to pigs and trees. It is usually desirable to ring pigs before turning them out to pasture.

Soiling implies the cutting of the crop for consumption at the homestead. In this connection cattle-feeding yards, generally empty in the summer months, might be more widely used to supplement the special accommodation usually set apart for pigs.

Crops necessitating relatively little trouble or expense in growing, and suitable for soiling, include the following :—

Lucerne ; red clover ; rye ; vetches (pure), or mixed with a cereal or with rape ; rape ; and maize.

The following table gives the approximate times for sowing and using these crops :—

Crop.	Time of Sowing.	Time for Using.
Lucerne .. ; Clover	Spring of previous year	Throughout the season.
Rye	Autumn	April and May.
Vetches and cereal ..	Autumn	May and June.
Vetches, cereal and rape*	Early Spring	June and July.
Rape	April and May ..	July and August.
Maize	End of May	August.
Rape,* vetches and cereal	June	September and October.

* About 5 lb. per acre of rape should be sown broadcast and rolled in after the oat and vetch crops are well above the ground.

It should be clearly understood that the times stated above will vary according to climate and season. Full particulars concerning the cultivation of lucerne and red clover will be found in Leaflets Nos. 160 and 184, respectively. The cultivation of the other crops is dealt with in Special Leaflet No. 28. Notes relating to the comparative values of feeding stuffs are issued from time to time in the Board's *Journal*, and further detailed information as to the use and purchase of feeding stuffs will be found in the following Leaflets :—

No. 74.—The Composition and Properties of Concentrated Feeding Stuffs.

No. 79.—Rations for Farm Stock.

Special Leaflet No. 8.—The Utilisation of Cereal Offals and certain other products for Feeding Purposes.

Special Leaflet No. 10.—Pig-Keeping for Cottagers and Small Holders.

Special Leaflet No. 16.—Notes on Pig Feeding.

Sorghum.

THOUGH widely grown and much prized, in America, for feeding in the green state, Sorghum is little known in this country. During the past few years, however, experiments conducted in Essex by the East Anglian Institute of Agriculture have indicated that two species of Sorghum, viz., *Sorghum vulgare* and *Sorghum saccharatum*, may prove distinctly useful additions to the forage crops of the warmer parts of this country.

In general appearance and habit of growth Sorghum resembles maize; its stem, however, is much more slender, and it has a narrower leaf. Its requirements as regards soil and climate appear to be almost identical with those of maize. Like maize, also, it thrives in abundant sunshine, and is easily killed by frost.

Soil.—The character of the soil is of less importance than its mechanical condition. Sorghum possesses an extremely well-developed root system, and is capable of resisting drought. The soil, however, must be well drained, the sub-soil fairly open, and the tilth fine, firm, and free from weeds.

Manuring.—Sorghum is a vigorous grower, and will generally pay for liberal manuring. About 10 tons of dung per acre should be applied in autumn, or early winter, and the following artificials shortly before the seed is sown:—

2–4 cwt. superphosphate, and } per acre.
¾ cwt. sulphate of ammonia or 1 cwt. nitrate of soda }

If dung is not available the artificials should be increased.

Time and Method of Sowing.—The seed should not be sown until the soil is thoroughly warm, in spring, and risk of the plant being damaged by frost is past: from the middle to the end of May is usually the most suitable time. The seed may be sown broadcast, or in rows, the former only if the land is thoroughly clean. Sown broadcast, or in narrow rows about 7 in. apart, the plant grows tall with thin stems, and produces an abundance of leaves. If the whole crop is not utilised for feeding green, the surplus may be made into hay, if the weather is favourable, or converted into silage. In 1914 a crop of *Sorghum vulgare*, grown as described, reached a height of 7 ft. in Essex, and produced over 20 tons of green forage per acre. In a suitable season an excellent supply of succulent green fodder might be obtained by the end of July, but the maximum yield is not reached till about the middle of August.

The quantity of seed required will vary according to the method of sowing, and the character of the tilth. When drilled in rows, 7 in. apart, 20 lb. per acre should be ample.

As different stocks are on the market, Sorghum seed, preferably American grown, should be obtained from a reliable seedsman.

Utilisation.—The crop is usually cut green, as already indicated, and fed in the same way as maize. It is specially valuable for feeding to dairy cows in late summer when the pastures begin to fail. Although not quite so productive as maize, it possesses at least two advantages over that crop; it is ready for cutting a week or two earlier, and the cost of the seed is less. The normal price of Sorghum seed is about 3*d.* per lb. (at present it costs from 3*d.* to 5*d.*, so that an acre may be sown at a cost of from 5*s.* to 8*s.* 4*d.*) White Horse Tooth Maize, on the other hand, which is usually sown at the rate of 2 bushels per acre, is quoted in seedsmens' catalogues at from 9*s.* to 12*s.* 6*d.* a bushel—or 18*s.* to 25*s.* per acre.

Although, so far as the Board are aware, no harmful effects have followed the feeding of Sorghum in this country, it is well to indicate that in hot countries green Sorghum has been known to produce injurious and even fatal results. In America it is considered dangerous to feed second-growth Sorghum, but the first cut is generally regarded as quite safe.

It is worthy of note that where Sorghum and maize will grow well, they will probably yield at least as much dry matter per acre as an average root crop grown under the same conditions, at much less cost, and in a shorter time. An additional advantage is that the shade they give has the effect of suppressing weeds.

Mussels as Manure.

AN enquiry made by the Board in 1914 elicited the fact that very little use is made in England of mussels as manure, Kent and Essex being the only two counties in which they are purchased to any appreciable extent by farmers for this purpose. Analyses which were forwarded to the Board in some instances show, however, that mussels would have a certain manurial value; the whole mussel (shell and contents) would seem to contain from 0·7 to 1·0 per cent. of nitrogen; 0·14 to 0·54 per cent. of phosphate; and from 0·09 to 0·13 per cent. of potash. On the basis of these figures mussels might have an average value for manurial purposes of about 12*s.* a ton.

Besides the substances mentioned mussels contain considerable quantities of carbonate of lime (the shells consist almost wholly of this substance). It would take some time

for the shells to break up (they would probably not decompose until at the earliest in the year following application) and for the carbonate of lime to be of any use in the soil. Further, nearly all the nitrogen is contained in the "fish," and hence the mussels should be crushed and dug in. If they were simply spread over the land, the contents would decay inside the shells, and as the fish would not come in contact with the soil until the shells were dissolved much of the nitrogen might escape as ammonia without being absorbed, and the mussels might therefore have very little value. From this point of view, as well as from the desirability of rendering the carbonate of lime more quickly available, grinding would be an advantage.

Mussels have been used as a manure for many crops in Kent, but especially for mangolds and other roots, potatoes, cabbage, cauliflower and celery. The lime and organic matter present would be useful on light soils, while an improvement in the working of heavy soils as a result of the use of mussels is reported in Essex.

The price of mussels in Essex seems to be 20*s.* per 100 bushels out of boats alongside, 150-200 bushels per acre being used. In Kent the cost is 8*s.* to 9*s.* per ton ex wharf at Faversham; and Whitstable mussels are sold at 15*s.* per ton to any Kent railway station within reasonable distance.

It must be pointed out that the use of fresh mussels as manure seems a wasteful proceeding, as it means the dissipation of the energy stored in the conversion of inorganic into organic substances; it might be profitable to dry the mussels and make them into a feeding meal as in the case of other fish and fish offal.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

The Effect of Straw on the Utilisation of Organic Manurial Nitrogen (*Mitt. der Landw. Lehrkanzeln der K.K. Hochschule für Bodenkultur in Wien,* Bd. II., Heft 3, 1914).—As a result of experiments carried out at the Imperial High School for Soil Culture at Vienna the conclusion is reached that the utilisation of organic manurial nitrogen (*e.g.*, the nitrogen in dung) by plants grown immediately after manuring is adversely affected by the addition of a non-nitrogenous organic substance—in this instance straw—and that the extent to which this is

* A summary of all reports on agricultural experiments and investigations recently received is given each month. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.

the case depends upon the ratio between the straw and the available nitrogen in the dung and soil. The greater the proportion of straw the greater is the adverse effect, and (other things being equal) those plants which satisfy their need for nitrogen in a short time suffer most. The withdrawal of soluble nitrogen by micro-organisms of the soil which use the straw as a source of energy is indicated as the cause of this phenomenon.

Storage and Application of Farmyard Manure (*Fühlings Landw. Zeitung*, 1st March, 1914; *Dr. F. Löhnis and J. Hunter Smith, B.Sc.*).—One of the greatest of agricultural problems is to utilise as fully as possible the plant nutrients in farmyard manure and to lessen the loss of nitrogen. It is considered that a solution of the problem may be found in the separate collection and storage of the dung and urine. The difficulty of collecting and storing large quantities of urine is obviated by the use of peat moss litter and this lessens the loss of nitrogen as ammonia.

The separate utilisation of the dung and straw mixture on the one hand and of the urine (with or without peat moss) on the other would appear to be rational not only because the loss is lessened, but because the two manures are so essentially different in their effects.

Thus the mixture of dung and straw depends for its value chiefly on its high bacterial content and its richness in humus-forming organic substances; its manurial effect is small—in the first few years and under the most favourable conditions the utilisation of the nitrogen is only 20 per cent. About half the nitrogen in dung is in the form of living and dead bacteria, and the other half in the form of undigested food constituents; a quick mineralisation of both parts is, therefore, out of the question; further, the plant nutrients in straw can only be very gradually broken down by the bacteria in the manure and the soil.

Urine, on the other hand, is relatively poor in bacteria and humus-forming substances, and rich in quickly available plant nutrients. Farmyard manure composed of a mixture of solid and liquid excreta often has a better effect in the first year than urine-free farmyard manure, but by the second year the advantage disappears, and the first year's advantage is often dearly obtained through the larger losses in storage and the incomplete utilisation of the plant nutrients in the urine. Used rationally (*i.e.*, separately) the nitrogen in the urine acts as rapidly as that in sulphate of ammonia or nitrate of soda.

Peat Moss Litter Manure (*Deut. Landw. Presse*, 20th February, 1915).—Owing to the shortage of nitrate of soda and sulphate of ammonia in Germany as a result of the demands made by the military authorities, top dressing with peat moss litter manure is being advocated. In the experiment detailed in this paper nearly as good results were obtained from peat moss litter manure as from nitrate of soda as top dressings for winter rye. It is usually recommended that the peat moss should be mixed with liquid manure by simple shovelling; this experimenter, however, advocates placing the peat moss at the bottom of the dung heap so as to absorb the constituents of the liquid manure washed down by the rain.

Partial Sterilisation of Soil by Antiseptics (*Jour. Agric. Sci.*, December, 1914; *W. Buddin, B.A.*).—A large number of such antiseptics as are easily volatile and removable from the soil were shown to produce true partial sterilisation of soil (see previous articles in this *Journal*), and were undoubtedly effective in increasing the productive capacity

of a soil under laboratory and pot culture house conditions, although they were unsuitable for application on the larger scale. Antiseptics which are not completely removable from the soil were, on the other hand, shown to have some lasting influence on the bacterial flora.

Experiments with Nitrogenous Manures (*Fühlings Landw. Zeitung*, 1st January, 1915.)—A scheme for testing various points in connection with manures has been carried out for several years at six German experiment stations.

With nitrate of soda there was found, in the aggregate, to be little difference whether the whole dressing was applied before sowing or whether half was so applied and half was given afterwards as a top dressing. Taking the yields of the crops when the manure was applied in one dressing as 100 the yields when the manure was applied in two dressings were as follows (of grain, tubers or roots, as the case may be): Rye 105, barley 103, oats, 102, potatoes 103, sugar beet 90. On the lighter soils it seems better to give the nitrate of soda in two dressings; on the heavier soils this has only proved profitable for barley and potatoes, a single dressing being more profitable for oats and sugar beet.

In comparing sulphate of ammonia and nitrate of soda as sources of nitrogen (equal amounts of nitrogen in the two cases) nitrate of soda proved superior in the great majority of cases. Representing the yields from nitrate of soda as 100 those from sulphate of ammonia were: Rye 93, barley 89, oats 97, sugar beet 95, potatoes 94, mangolds 68. Sulphate of ammonia, however, gave better results on a moor soil than nitrate of soda, and the yields from the former approached those of the latter more nearly on sandy than on loam soils. With rye, sulphate of ammonia gave better results when applied in spring than when given in autumn. The experiments bore out the general experience that autumn-sown cereals require very little nitrogen in autumn and that if not assimilated some of the nitrogen in both manures is washed out during the winter. Top dressing with sulphate of ammonia was not tried, as previous experiments had shown that inferior results had been obtained from using sulphate of ammonia in this way.

Calcium cyanamide proved much inferior to nitrate of soda and inferior also to sulphate of ammonia. Representing the yields from nitrate of soda as 100 those from calcium cyanamide were: Rye 74, wheat 87, barley 75, oats 79, sugar beet 66, potatoes 78, mangolds 72. Nitrate of lime was very similar in its action to calcium cyanamide. There were no noteworthy differences between the effect of calcium cyanamide on sandy and loam soils. The application of the manure in autumn was much less profitable than in the spring, and gave best results when applied very shortly before sowing (except with sugar beet). Inferior results were obtained from using the manure as a top dressing. With rye, sugar beet and potatoes, the superiority of nitrate of soda was increased with increased dressings of both manures.

The experiments showed that, on the average, 39 per cent. of the nitrogen given in the form of nitrate of soda was lost to the crop. Representing the utilisation of the nitrogen in nitrate of soda (*i.e.*, 61 per cent.) as 100 the utilisation of that in sulphate of ammonia and calcium cyanamide was 78 and 65 respectively. The nitrogenous manuring had very little effect (if any) on either the *percentage* content of the crop in nitrogen or the quality of the produce (starch content of grain and potatoes and sugar content of roots).

FIELD CROPS.

Varieties of Potatoes (*Northants C.C. First Ann. Rept. on Field Expts.*, 1914).—The total yields on a clay loam were (per acre):—Arran Chief, 11 tons 8 cwt.; Up-to-Date, 10 tons 3 cwt.; International Gem, 9 tons 11 cwt.; King Edward, 9 tons, 10 cwt.; King George, 8 tons 19 cwt. The total yields on a medium loam were (per acre):—Up-to-Date (Irish seed), 10 tons 4 cwt.; Arran Chief, 9 tons 6 cwt.; International Gem, 9 tons 4 cwt.; Abundance, 8 tons 13 cwt.; Up-to-Date (local seed), 8 tons 6 cwt.; King George, 7 tons 19 cwt.; King Edward, 7 tons 10 cwt. Except in the case of Up-to-Date (as indicated) the seed was obtained from either Scotland or Ireland. Arran Chief is a late or main crop potato, round in shape and having a strong upright haulm; it appears to be an excellent cooker.

Varieties of Potatoes (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—In 1914 the land received dung and artificials; the seed was obtained from Perthshire and Montrose; the crops were lifted on the following dates:—Earlies July 30th, second earlies August 17th, and lates October 5th.

Amongst the earlies Duke of York, Eclipse and Epicure proved the most productive, Eclipse and Epicure having given very good yields during the past four seasons. The total yields in 1914 were as follows (per acre):—Duke of York 8 tons 8½ cwt., Eclipse 8 tons 7¾ cwt., Epicure 8 tons ¾ cwt., Midlothian Early 7 tons 6½ cwt., Sharpe's Express 6 tons 2¼ cwt. Although as regards total yield Eclipse was slightly superior to Epicure, the latter produced a much larger proportion of saleable potatoes.

As regards second earlies British Queen was the heaviest cropper in the trials conducted in 1911, 1912 and 1913, and was only 5 cwt. per acre behind the heaviest cropper in 1914. Two new varieties, D5 and White's Seedling, gave satisfactory results. D5 and King George produced a large proportion of ware. The following were the total yields per acre in 1914:—D5 12 tons 4 cwt., British Queen 11 tons 19 cwt., White's Seedling 11 tons 10½ cwt., King George V. 11 tons 1¼ cwt., King Edward VII. 10 tons 1½ cwt., Arran Early 9 tons 6½ cwt., Queen Alexandra 9 tons 4½ cwt.

The yields of late varieties per acre were as follows in 1914:—Caledonian and Legaston Don 13 tons 6 cwt., Baronet 13 tons 3½ cwt., Ajax White 12 tons 17¾ cwt., Record 12 tons 15¼ cwt., Scottish Farmer 12 tons 14½ cwt., Dalhousie 12 tons 7 cwt., Up-to-date (Perth) 12 tons 4¾ cwt., Ajax Red 12 tons 3 cwt., What's Wanted 11 tons 8¾ cwt., Arran Chief 11 tons 4½ cwt., Northern Star 11 tons 1¾ cwt., Dalmeny Regent 11 tons 1 cwt., Kidd's Seedling 9 tons 18¼ cwt. Scottish Farmer produced a very high percentage of ware and the best sample of tubers.

Varieties of Potatoes (*Lincs. (Lindsey) C.C. Educ. Com., Bull. No. 2*, 1914-15).—Trials were carried out at the Midland Agricultural and Dairy College to test the cropping powers of a large number of potatoes. Of the early varieties Epicure gave the best results, followed by Ninety-fold and Midlothian Early. The leading varieties among the second earlies, given in order of yield, were Dalmeny Radium, British Queen, Craigie Early and Pioneer. Of the main crop varieties, excluding small and diseased potatoes, the highest yielders, in the order given, were King George V., Evergood, Queen Mary, Arran Chief, Ajax (white), Chapman, and Ajax (red). The variety Queen Mary produced practically equal amounts of ware and seed.

Particulars as to the other varieties tested are given in the bulletin, as well as the results of small-plot potato variety experiments carried out on four farms in the county.

The Action of Manures on Grassland (*Jour. Agric. Sci.*, December, 1914; *R. G. Stapledon, M.A.*).—The various types of grassland in this country are capable of being classified according to fairly definite botanical characteristics, and are associated with definite geological formations or topographical features. The writer defines a "type" as "a plant community consisting of fundamental and subsidiary species, and being such that the contribution of each fundamental species to the total flora tends to be close to an optimum figure and does not increase above a certain maximum or decrease below a certain minimum."

Great change in environment causes even the chief species either to advance beyond their maxima or to recede below their minima, so giving rise to a different type. The prevailing husbandry is an environmental factor, sheep grazing, cattle fattening, the periodic removal of hay and manuring being capable of altering the type.

The action of manures depends on—

(1) Factors which are always operative, *e.g.* (*a*) botanical composition of herbage (before manuring) in relation to the type of grassland prevailing; and (*b*) meteorological conditions.

(2) Indirect factors, *e.g.* (*a*) disturbance of prevailing equilibrium of species, awakening competitive interaction; (*b*) effect on physical, chemical and biological properties of soil, thus modifying the texture and water capacity of the soil and the availability of plant foods.

(3) Factors directly dependent on the chemical composition of the manures, *e.g.* (*a*) the individual appetites of the several species for the particular plant foods in the form they are added, and (*b*) the physiologically depressing effect particular manures may produce on the individual species.

Manuring for Mutton (*E. Suffolk County Educ. Com., Rept. on Field Expts., Circ.* 15, 1915).—There are two plots only; one is unmanured, the other received 10 cwt. of basic slag in 1904 and again in 1912. The gain in live weight of sheep grazing the slagged pasture over that of animals on the unslagged pasture from 1905 to 1914, when valued at 3¾*d.* per lb., has resulted in an average profit per acre per annum of 15*s.* 10*d.*

Manuring of Grassland (*Northants C.C., First Ann. Rept. on Field Expts.*, 1914).—Experiments in the manuring of grassland were commenced in 1914 at five centres in Northamptonshire on land typical of the very large areas of poor cold pastures, on clay land, which are found throughout the county. Mechanical and chemical analyses of the soil at each centre are given, together with the results of the first season's work. Superphosphate was usually more effective than slag, although slag did better than might have been expected considering that it was applied late and that the season was dry. The report itself should be referred to for the results in detail.

Manuring of Meadow Hay (*Jour. Dept. of Agric. and Tech. Instr. for Ireland*, January, 1915).—In the liquid manure test in 1914, carried out at 81 centres, the increased yields of hay per acre resulting from manuring were as follows:—16 tons dung, 15¾ cwt.; 16 tons liquid manure, 16 cwt.; 1 cwt. nitrate of soda, 2 cwt. superphosphate and 2 cwt. kainit, 15¼ cwt.

The experiment with artificials on peaty soils in 1914 showed the most profitable dressing to be 1 cwt. nitrate of soda, 2 cwt. super-

Manuring for Hay (*East Anglian Inst. of Agric., Rept. on Field Expts.,* 1914).—The field used had been down to pasture for many years. The soil was a deep loam. Various combinations of manures were applied to ¼ acre plots on March 24th, the crop being cut on June 22nd. The manuring and yields of hay were as follows (per acre) :—

Manure.	Yield. tons	cwt.
No manure	1	12
1½ cwt. nitrate of soda	2	6½
1½ ,, ,, ,, and 5⅓ cwt. superphosphate	2	7
1½ ,, ,, ,, and 5 cwt. basic slag ..	2	0
1⅛ ,, sulphate of ammonia and 5⅓ cwt. superphosphate	2	4½

Manuring of Poor Meadow Land (*E. Suffolk County Educ. Com., Rept. on Field Expts., Circ.* 15, 1915).—These experiments were commenced in 1901 on a field of exceedingly poor clay land. The following table shows the scheme of manuring and the cost, the total weight of hay produced in 12 years, 1902–14 (the land was grazed in 1908), and the profit from the treatment (figures per acre) ; the hay is valued at 50*s.* per ton :—

Plot.	Treatment.	Cost of Treatment (13 years) £	s.	d.	Weight of Hay (12 years) cwt.	Profit from Treatment (12 years). £	s.	d.
1*a*	10 cwt. basic slag, 1901, 1907 and 1912	3	2	6	325	23	12	6
1*b*	As on 1*a* + 2 cwt. kainit, 1909 and 1912	3	11	6	326	23	7	3
2*a*	5 cwt. basic slag, 1901, 1904, 1907 and 1912 ; 2 cwt. kainit, 1909 and 1912	2	10	8	269	16	7	10
2*b*	As on 2*a* + 1 cwt. nitrate of soda, 1909 and 1912	3	9	6	282	17	1	0
3	7 cwt. super., 1901, 1904, 1907 and 1912	3	10	0	290	18	16	3
4	Unmanured	—			114	—		
5	As on 3 + 3½ cwt. kainit, 1901, 1904, 1907 and 1912	5	1	6	316	20	3	6
6	As on 3 + 10 cwt. lime, 1901, 1904, 1907 and 1912	5	10	0	313	19	8	9
7	As on 3 + 71 lb. sul. am., 1901, 1904, 1907 and 1912	5	3	9	334	21	12	0
8	6 cwt. dissolved bones, 1901 ; 3½ cwt. bone meal, 1904, 1907 and 1912	5	0	2	279	13	18	7

The addition of kainit thus increased the profit on the superphosphate plots and decreased it on the basic slag plots, the probable explanation being that the soil contained sufficient potash, which was liberated by the lime in the basic slag on the plots where this latter manure was used.

Manuring of Clover (*E. Suffolk County Educ. Com., Rept. on Field Expts., Circ.* 15, 1915).—In an experiment to test the effect of mineral manures upon clover the most profitable dressing proved to be 4 cwt. superphosphate and 1 cwt. muriate of potash per acre, the next best being 4 cwt. superphosphate alone. Dressings of basic slag, although profitable, were inferior to those of superphosphate, a fact perhaps accounted for by the dry season of 1914.

LIVE STOCK, FEEDING AND DAIRYING.

Calf Feeding (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Sixteen shorthorn calves were fed for a preliminary period on new milk and then divided into four lots to test different methods of feeding. In Lot 1 each calf received 6 quarts of new milk daily throughout the experiment (10 weeks) and no other food. With Lot 2 the new milk was gradually reduced and a gruel substituted containing 2 parts oatmeal, 1 part ground linseed and 2 parts maize meal, and costing 12*s.* 8*d.* per cwt.; at the beginning the calves each received (per day) 4 quarts new milk and 2 quarts gruel made from ½ lb. of the meal, and at the end 3 quarts new milk and 3 quarts gruel made from ¾ lb. of the meal. With Lot 3 the gruel used with Lot 2 was replaced by one containing 5 parts ground linseed, 14 parts linseed cake meal, 2 parts flour and 2 parts locust bean meal, and costing 11*s.* 6*d.* per cwt.; at the beginning the calves each received (per day) 4 quarts new milk and 2 quarts gruel made from ½ lb. of the meal, and at the end 2 quarts new milk and 4 quarts gruel made from 1 lb. of the meal. The calves in Lot 4 received per head per day 6 quarts of separated milk, and at the commencement 2 oz. cod liver oil and ½ lb. crushed oats, the quantities of the two latter foods being increased eventually to 3 oz. and 1 lb. respectively.

The results of the experiment were as follows:—

—	Lot 1.	Lot 2.	Lot 3.	Lot 4.
	lb.	lb.	lb.	lb.
Weight at start (4 calves) ..	638	638	634	632
Increase in weight in the 10 weeks.	458	284	346	407
Cost of this increase (food only)	£14	£9 11*s.*	£7 14*s.*	£4 15*s.*
Cost per lb. increase	7·25*d.*	8·06*d.*	5·34*d.*	2·80*d.*
	lb.	lb.	lb.	lb.
Weight 14 weeks after experiment terminated	1,475	1,258	1,424	1,422

Mouldiness in Butter (*Jour. Agric. Research*, January, 1915).—In this paper mouldiness in butter is considered from the biological standpoint. The main points of practical interest brought out are that excess of curd favours growth of mould; that well-washed butter is less subject to mould; that butter from which water of buttermilk exudes and collects in the wrappings or container furnishes the best conditions for the beginning of the growth of mould, mould colonies possibly spreading from these wet areas to the butter itself; that wet surfaces, wet wrappings or high humidity are essential to the growth of mould in butter; and that salt up to 2·5 or 3 per cent. in butter is sufficient to eliminate mould or reduce it to negligible amount (this being equivalent to the use of a 12 to 15 per cent. brine).

Fat Lambs from Welsh Crosses (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Ewes of the Improved Welsh breed were divided into three flocks and mated with pure-bred Ryeland, Romney Marsh and Improved Welsh rams. The lambs were dropped in February and March, all appearing hardy and strong; and all ewes and lambs were fattened together and sold from May to August. The following were the results:—

—	Ryeland.	Romney Marsh.	Welsh.
No. of ewes lambed	18	18	18
Lambs dropped	32	28	26
Average No. of lambs per ewe ..	1·7	1·5	1·4
Live weight when sold	80 lb.	84 lb.	75 lb.
Average price realised for lambs	35*s.* 9*d.*	35*s.* 3*d.*	34*s.* 7*d.*
Total for lambs	£57 4*s.*	£49 7*s.*	£44 19*s.*
Average per ewe by sale of lambs	£3 3*s.* 6*d.*	£2 14*s.* 10*d.*	£2 9*s.* 11*d.*

The Fattening of Unprofitable Dairy Cows (*Jour. S.E. Agric. College, Wye,* 1913, ; *C. Hutchinson, B.Sc.*).—This experiment was designed to obtain further information as to the advisability of substituting a fattening ration for the normal milk production ration in the case of barren cows, with the view of fattening them for slaughter when they dry off. Five Shorthorn cows were utilised ; they were in healthy milking condition, and typical of the drafts which occurred year by year in a herd of 25 cows.

The test was divided into 3 periods. During the first period, from 24th October to 19th December, each cow received on the average a maintenance ration of 40 lb. swedes or mangolds, 7 lb. meadow hay 14 lb. oat straw, 2 lb. Egyptian cotton cake, and 1 lb. molascuit per day, and as a milk-producing ration each animal was given 4 lb. of a mixture of equal parts of Egyptian cotton cake, crushed oats, gluten feed and bran daily for each gallon of milk she produced. The financial results of the first period were as follows :—Value of 3,852 lb. of milk, £12 16*s.* 9½*d*, value of 122 lb. live weight increase, £2 5*s.*, less cost of maintenance ration, £9 18*s.* 4*d.*, and of milk-production ration, £4 2*s.* 6*d.*, giving a profit over the cost of food of £1 0*s.* 11½*d.* for all the cows.

Throughout the second period, from 19th December to 13th February the cows were confined to stalls and received, in addition to the food previously allowed, a fattening ration of 6 lb. each per day of a mixture of 2 parts linseed cake and 1 part each of Egyptian cotton cake, dried grains and gluten feed. The returns of the second period were :—Value of 3,807 lb. of milk, £12 13*s.* 9½*d.*, value of 454 lb. live weight increase, £8 7*s.* 6½*d.* ; less cost of maintenance ration, £9 18*s.* 4*d.*, milk-production ration, £4 1*s.* 7*d.*, and fattening ration £5 15*s.* The excess of the returns over the cost of food was thus £1 6*s.* 5*d.*

During the third period, from 13th February until each cow was sold, the average duration being seven weeks, the milk-production ration was discontinued, and 4 lb. per head per day of para rubber seed cake were added to the fattening ration. The cows were dried off as quickly as possible and sold when sufficiently fat. The results for the third period were :—Value of 895 lb. of milk, £2 19*s.* 8*d.*, value of 357 lb. increase in live weight, £6 11*s.* 9*d.* ; cost of maintenance ration, £8 11*s.* 5*d.* and cost of fattening ration £8 8*s.* 6*d.* The cost of the food thus exceeded the returns by £7 8*s.* 6*d.*

No attempt was made to take into consideration the residual manurial value of the food consumed or to include expenses other than the cost of food. From the results obtained, however, it was concluded that the milk yield of a barren cow should not be allowed to reach an unprofitable level before a fattening ration is allowed. The introduction of such a ration to a cow in milk and already suitably fed will arrest

the normal decline in milk yield, and produce a considerable live weight increase. The results of the third period suggested that the interval between drying off and sale should be made as short as possible.

DISEASES OF ANIMALS.

Bacillary Necrosis of the Liver in Unborn Lambs (*Jour. S.E. Agric. Coll., Wye*, 1913; *T. W. Cave, F.R.C.V.S.*).—In March, 1913, the College received a report from a sheep owner that his ewes were dropping a large proportion of still-born lambs. Ten dead lambs were received and examined at the College, and eight were found to have "spotted" livers. In all the eight cases the same diseased areas were found in the liver.

A microscopical examination of the diseased areas was made and the presence of the bacillus of necrosis was determined. A culture was prepared, and a rabbit was inoculated. In ten days extensive necrosis of the skin was seen, and on killing the animal the disease was found to have extended through the muscles of the abdominal wall at the groin down to the peritoneum.

It was concluded that the loss of about 100 lambs, mostly still-born, was due to bacillary necrosis of the liver, but no evidence could be obtained as to the origin of the disease, though it appeared that in most cases the disease must have existed for some considerable time before birth. It was, unfortunately, impossible to test the presence and nature of the disease in the ewes, but it is hoped that further investigations may be made should the disease reappear.

WEEDS.

The Identification of the Country of Origin of Commercial Samples of Oats (*Roy. Agric. Coll., Scientific Bull. Nos. 4 and 5; C. B. Saunders*).—Considerable quantities of oats are imported into England for feeding purposes, and, while many are of excellent quality, such oats are sometimes sold as, or admixed with, English oats, and it is somewhat difficult for the inexperienced buyer to detect the substitution.

In this investigation a detailed examination was made of the weed impurities in samples of the 1912 crop of oats from Argentina, Germany, Russia, Canada and the United States, and the results were classified. The results show that it is possible to state, with reasonable accuracy, the district from which a given sample may have originated.

On an average Russian oats were found to contain the largest quantity and the greatest variety of impurity, some samples containing nearly 5 per cent., by weight, of weed seeds and dirt. Argentine oats were next in order, followed by those from Germany, Canada and the United States. Apart from impurities, the best feeding samples were Canadian and German oats; Russian oats were very variable, while American and Argentine oats were usually thin, husky and of low bushel weight.

Russia.—There did not appear to be any very great difference between the weed impurities of the north and south Russian oats, about 50 to 60 species being found. The most characteristic features were the abundance of *Lychnis Githago* and species of vetch, especially *V. sativa* and *V. angustifolia*; the usual occurrence of *Panicum miliaceum*, *Setaria glauca*, *Galeopsis tetrahit* and *Convolvulus arvensis*; the frequent occurrence of *Euphorbia* sp., *Neslia paniculata*, *Scleranthus annuus*, and *Raphanus* and *Melilotus*.

Germany.—Oats from the north-east of Germany exhibited practically the same impurities as Russian oats, but were generally better cleaned; in samples from north-central Germany *Raphanus* and *Centaurea cyanus* were especially abundant; whilst in south German oats *Centaurea* was uncommon and *Galium* frequent. Considering all German samples together, the weeds usually present in large numbers were *Polygonum Convolvulus, Raphanus Raphanistrum* and *Centaurea cyanus*; those usually present in small quantities were *Vicia hirsuta, V. angustifolia, Brassica arvensis, Polygonum lapathifolium, Vicia sativa* and *Lychnis Githago*; those present in many cases were *Ornithopus sativus, Spergula arvensis, Galeopsis tetrahit* and *Galium aparine*.

Canada.—The weeds usually present in large quantities were *Polygonum convolvulus* and *Chenopodium* sp.; those usually present in small quantities were *Neslia paniculata, Linum usitatissimum* and *Lappula echinata*; those present in many cases were *Thlaspi arvense, Brassica* spp., and *Camelina sativa*. The characteristic features of the weed impurities in Canadian oats appear to be the usual occurrence of *Neslia paniculata* and *Lappula echinata*, and the frequent occurrence of *Thlaspi arvense* and *Camelina sativa*.

United States.—American oats naturally exhibited impurities somewhat similar to Canadians. The principal differences were the more frequent occurrence of *Setaria glauca* and, to a less extent, of *Rosa pratincola*, and the larger quantities of seed of *Brassica* spp. present. The weeds usually present in large quantities were *Brassica* spp.; those usually present in small quantities, *Polygonum Convolvulus, Setaria glauca* and *Chenopodium* spp.; those present in many cases, *Rosa pratincola, Setaria viridis, Polygonum Persicaria*.

Argentina.—Apart from very dirty samples of Russian oats, Argentine samples were more readily identified by their weed seed contents than any other. The species of diagnostic importance were *Anthemis Cotula, Lolium temulentum*, and, more particularly, *Silybum marianum* and a species of *Phalaris*; in addition, the amount of *Avena fatua* and *Melilotus* was larger than in other samples, and *Centaurea solstitialis* was not infrequently found, whereas it was not identified in any other cases. The weeds usually present in large quantities were *Melilotus alba, Brassica campestris* and *Avena fatua*; those usually present in small quantities, *Anthemis Cotula, Lolium temulentum, Polygonum Convolvulus, Phalaris* sp., *Lychnis Githago* and *Silybum marianum*; those present in many cases, *Linum usitatissimum, Medicago lupulina, Raphanus Raphanistrum, Stellaria media*, an *Umbellifer* and *Lithospermum arvense*.

HORTICULTURE.

Cider Sickness (*Jour. Bath and West Soc.*, 1914–15; *B. T. P. Barker, M.A.*).—Experiments carried out at the National Fruit and Cider Institute showed that cider sickness may be prevented (1) by mixing the sick cider with a sharp cider in such proportion that the acidity of the mixture is at least ·5 per cent., (2) by adding tartaric acid at the rate of about 2 to 4 lb. per 100 gal., (3) by adding thick brewers' yeast (which has been well washed) in the proportion of 1 part to 120 by volume.

On the other hand, aeration and the addition of sulphur-dioxide gas were of no use in remedying sickness.

Brewers' yeast has the disadvantage that it reduces the sweetness of the cider and it cannot be used if it is desired to keep the cider at the original high gravity, because, to ensure a good result, it is necessary to ferment the cider 10 to 15 points down, thus changing it from a sweet cider to a drier one. Pressed German yeast, in the proportion of about 2 lb. per 100 gal. of cider, can be used in the place of brewers' yeast.

Sweetening of Cider (*Jour. Bath and West Soc.*, 1914–15; *B. T. P. Barker, M.A.*).—Results were obtained somewhat contrary to previously accepted views in this country as to the relative merits of cane sugar and beet sugar for sweetening cider. Most of the samples of cider sweetened with cane sugar did not keep, but were attacked by a bacterial disease, whereas all the beet sugar samples remained in good condition. But, apart from this, the flavour of the cane sugar samples was inferior in all cases (except where the respective raw sugars were compared, when there was no difference), the peculiar flavour of the cane sugar being easily detected, while the beet sugar gave no new flavour to the cider.

Blackening of Cider (*Jour. Bath and West Soc.*, 1914–15; *B. T. P. Barker, M.A.*).—It is sometimes the case that cider which has been kept in bottles or casks, when poured out into a glass or otherwise exposed to the action of the air, changes colour in a short time, assuming a greenish-black tinge.

This investigation proved iron to be the cause of the abnormal colouring, iron getting into the juice from the iron mill, iron shovels, and other appliances of iron used in the making; it is also possible that soil adhering to the apples in some cases brings iron into the juice.

It is consequently essential to use iron appliances only when strictly necessary, and to clean them well before and after use. It is especially important that the juice and particles of pomace be removed when milling is finished for the day, because otherwise the acid from the fruit mill dissolves some iron which will get into the juice prepared the following day.

POULTRY.

Bacterial Content of Various Kinds of Eggs (*U.S. Dept. of Agric., Bull.* 51).—Experiments have shown that fresh eggs contain few bacteria or moulds and that evidences of bacterial decomposition in eggs cannot be recognised by sight and smell until the organisms have increased enormously in the food substance. This enquiry dealt with the extent to which changes due to temperature, humidity, odours, etc., are reflected in the composition of the egg, together with their recognition by physical, chemical and bacteriological methods. Individual eggs were examined bacteriologically in the laboratory and composite samples were tested chemically and bacteriologically in the packing house.

Laboratory Examination.—The great proportion of second-grade food eggs examined, medium stale eggs, hatch-spot eggs, heavy "rollers," dirty eggs, cracked eggs, and eggs with yolk partially mixed with albumen, contained less than 1,000 bacteria per gramme. The occasional high bacterial content of single cracked eggs, dirty eggs, etc., could in most instances be predicted by the appearance of the shell or by the odour and condition of the contents. *B. coli* was not present in the whole-shelled second-grade eggs and was present in only 5·9 per cent. of the cracked-shelled eggs. It was shown that 26·5 per cent. of

the eggs with adherent yolks, 50 per cent. of the eggs with dead embryos, 75·9 per cent. of the mouldy eggs, 66·7 per cent. of the "white rots," and 100 per cent. of the "black rots" contained over 1,000 organisms per gramme. With the exception of the white rots and black rots, *B. coli* was present in but few of the eggs.

Packing House Examination.—July and August first-grade eggs contained very few organisms, and in many cases no bacteria of the *B. coli* group.

The majority of the samples of clean-shelled second-grade eggs had a comparatively low bacterial content, only 8·3 per cent. of them containing over 1,000,000 organisms per gramme. The number of *B. coli* varied in the different specimens from 0 to 100,000 per gramme.

The percentage of bacterial counts over 1,000,000 per gramme in dirty eggs, eggs with cracked shell but intact membrane, and eggs with yolk partially mixed with albumen was 16·6, 18·8 and 20 per cent. respectively. No greater number of *B. coli* was found in these samples than in samples of second-grade eggs.

The samples of blood rings contained comparatively few organisms. The large blood rings in most instances showed more infection than did the small rings. Most of the specimens contained less than 10 *B. coli* per gramme.

The amount of protein decomposition, as shown by the ammoniacal nitrogen in the preceding types of eggs, was greater, as would be expected, than that found in strictly fresh eggs, but was no greater than that found in some grocery eggs. Although a cracked or dirty shell may be a factor in facilitating infection and subsequent decomposition, the data obtained show that cracked eggs with intact membranes, and dirty eggs, are as well preserved as the clean whole-shelled second-grade eggs or the July and August first-grade eggs.

The majority of the samples of "white rots," eggs with yolk lightly adherent to the shell, and all of the samples of sour eggs, "black rots," eggs with a green albumen and eggs with yolk heavily adherent to the shell, were infected with bacteria. *B. coli* was present in most of these samples, forming the predominating organism in the samples of sour eggs.

The eggs with yolk lightly adherent to the shell were, chemically, slightly lower in quality than were second-grade food eggs, whereas the sour eggs, "white rots," eggs with a green white, and eggs with yolk heavily adherent to the shell, showed much more deterioration. "Black rots" had five times as much ammoniacal nitrogen as any of these types of eggs.

MISCELLANEOUS.

Town Smoke and Plant Growth (*Jour. Agric. Sci.*, December, 1914; *C. Crowther, M.A., Ph.D., A. G. Ruston, B.A., B.Sc.*, and *D. W. Steuart, B.Sc.*).—Previous studies by these investigators had shown that the effect of smoke on plant growth is (1) to reduce the available solar energy, (2) to reduce the assimilatory powers of the plant leaves, and (3) to cause corrosion of the leaf tissue as a result of the presence of free acid in the air, this latter also causing indirect damage by way of the soil where the latter is poor in calcium carbonate.

Box experiments were carried out with soil from Garforth at each of six experimental stations in and near Leeds; the crops tested were radishes, lettuces, cabbages and wallflowers. Apart from a few slight irregularities the results indicated a fairly close correlation between

the relative degree of purity of the atmosphere and the actual amount of plant growth obtainable; further, evidence was obtained that the effects of the smoke were cumulative, the results at the most badly polluted centre becoming, in comparison, worse with each succeeding crop. As regards the injurious effects on the soil, analyses of samples of soil showed that it was a question of the inhibition of the activities of the nitrogen-adapting bacteria as well as the steady depletion of the stock of calcium carbonate.

Further box experiments were carried out with perennial rye-grass and buckwheat, but the results here do not seem to have been so conclusive as the foregoing.

The effects in detail of smoke on trees, grasses and cereals (plants and grain) are described.

The "Feuillette" Flax-Retting Process (*Annales de l'Institut National Agronomique*, 1914).—The decline in flax production in France is attribnted, partly to the competition with cotton, and partly to the inferiority of the processes for converting the raw material into fibre (*i.e.*, retting and scutching). Numerous attempts at retting by chemical means have proved unsuccessful, and large quantities of French flax have ordinarily to be taken to the Lys valley (N.E. France and Belgium) to be retted.

This publication describes a bacteriological process invented by M. Feuillette and recently tested by the French Machine Testing Station with excellent results. The process is as follows: After beating, the flax is tied into bundles, each consisting of four handfuls placed top against bottom so that the bundles are cylindrical. The bundles are then placed vertically in large wooden crates which are kept immersed in a trough; a small flow of lukewarm water is kept running into the retting trough, which may be of wood, stone, cement, etc.; the water in the trough is thus kept at about 25° C., the temperature which is recognised as being most favourable to the development of the retting bacteria. The process of retting develops a certain heat which contributes to the maintenance of this temperature, but at times it is necessary to run warm water or steam into the trough to maintain the temperature. The regular flow of warm water into the trough ensures the constant renewal of the water, a fact which is of importance as retting in stagnant water yields an inferior product; on the other hand, too strong a flow of water carries away some of the bacteria and thus weakens the bacterial action. The warm water is run into the bottom of the trough, and the water is run off at a higher level where the bacterial culture is most concentrated.

The crates filled with the bundles are kept immersed by a mechanical contrivance. The crates are taken out every day and reversed in the trough so that the bundles at the end of the process have been allowed to steep for an equal length of time each way; this is necessary to secure uniformity, as retting proceeds more quickly at the top of the trough than at the bottom; the retting bacteria are, further, aerobic, and this process has the effect of aerating the flax, while the bacteria of putrefaction and other harmful bacteria are prevented from multiplying.

The artificial retter has the advantage over the Lys retters, in that the different operations are under better control and the process is thus more sure and rapid. The crates in which retting is finished are taken out every day and the others are moved along in the trough. Fresh crates are placed at the end farthest from the inflow of water, *i.e.*,

where the bacterial culture is most concentrated, and moved along into less concentrated culture in accordance with the extent to which retting has proceeded, the flax stem being more sensible to the action of bacteria as retting proceeds.

After removal from the trough the flax is put into a washing and drying machine. This machine consists of a horizontal wheel divided into radial compartments in which the flax stems are placed, radially from the centre of the wheel, which is then set going slowly. A flow of water from the centre outwards removes the excess of gummy matter and all impurities from the stems. The water is then stopped and the machine turned quickly for drying, the water escaping through holes in the rim of the wheel. Drying is completed by placing the flax on a kind of hurdle on small waggons passed down a long passage ventilated with warm dry air. Drying is thus very safe compared with the operation as conducted in the open fields near the banks of the Lys.

Specifications of the machinery are given, together with a complete account of the trials at the Machine Testing Station. As Seine water was used with good results, the writer does not think that the water of the Lys has any bacterial properties more favourable to retting than water from elsewhere, and he ascribes the success of the Belgian retters to the rate at which the Lys water flows.

NOTES ON AGRICULTURAL CO-OPERATION.

An Italian Co-operative Cattle Insurance Society.

THERE are in Italy 812 societies for the mutual insurance of cattle, and it is instructive to study the working and history of one of them, which was founded in 1907 at Ferentino in the Province of Rome. Ferentino is a country town of considerable size, perched on the top of a hill some 50 miles south of Rome, amid picturesque mountainous scenery. The surrounding land is fairly fertile and well cultivated, the principal crops being vines, olives and wheat.

The agricultural holdings are generally small in area, and many are owned by the holders themselves. There are few outlying farm-buildings, and as most of the cultivators live in the town itself, they have often to go several miles to and from their fields, which must involve a considerable waste of time and make manuring operations difficult. Practically all the farm-work is done with bullocks, and seeing how much the loss of a cow or bullock may seriously embarrass a small farmer, a number of the more intelligent land-owners, at the instance of one of the itinerant lecturers on agriculture, with whom Italy is well provided, resolved to found a society for mutual insurance against losses from the death of cattle. The Society has been very successful, the number of members having risen steadily in the four years, 1910–13, from 122 to 336, almost all of whom are engaged in agriculture.

Constitution of the Society.—The ordinary membership of the Society is confined to owners of cattle residing within the *commune* (parish) of Ferentino, but cattle-owners residing in its immediate neighbourhood may also be admitted if the committee consider it possible to maintain without difficulty the necessary supervision over their cattle. In practice the Society's operations cover a circle of about three miles radius round the town. The entrance-fee, originally fixed at 1s. 8d.,

meeting half-yearly in February and August, but the ordinary management of its affairs is in the hands of a committee, consisting of a president, (at present the Mayor) a vice-president and five committee-men, elected from among the members, one of whom acts as treasurer. It has also a council of control, consisting of three members, which sees that the rules are carried out and the books properly kept, and has the power of calling a general meeting to deal with any irregularity it may notice, a secretary, and at least three inspectors, whose duty it is to visit and supervise the insured animals, especially those that fall sick. All these officials give their services gratuitously, although the rules allow of a salary being paid to the secretary.

Animals Insured, Compensation and Premiums.—The Society insures only horned cattle of not less than four months old, an insured animal being marked by fastening in its ear a stud bearing the Society's name and the animal's number as entered in the register, so as to make its identification easy. When a claim for compensation is established, the Society pays the owner four-fifths of the value at which the animal was insured, and receives any sum that may be obtained from the sale of the animal or its carcass. At first the rate of insurance contribution was fixed as follows on the value for insurance—

(1) For fattening, breeding and milch animals, 1½ per cent.
(2) For working bullocks, 2½ per cent.

After some experience however, the rates were revised and they now stand as follows :—

(1) Working bullocks, and breeding and milch cows—	
Up to £20	$2\frac{1}{10}$ per cent.
Over £20 and up to £30	3 ,,
(2) Calves and fattening animals—	
Up to £12	1½ ,,
Over £12 and up to £18	2 ,,

The maximum amount for which an animal can be insured is £30 for the first class and £18 for the second.

A bullock is generally set to work at two years old, but it is better not to break him in till he is two-and-a-half or three years old. In his prime at four years old, his average value is about £20. He can work till he is ten years old, but at about eight he is generally fattened for a few months and sold to the butcher, a good fat bullock fetching a price of about £24. A heifer is generally sent to the bull when she is eighteen or nineteen months old, and can go on bearing, perhaps eight calves, till she is ten years old, but before that she is generally fattened, and fetches a price of about £20 when sold fat.

The premium is paid in a lump sum in advance and the insurance takes effect from the 16th day after the date of the policy, and lasts till the end of the second half-year thereafter, the half-years ending for this purpose on the 30th June and 31st December. The policy can be renewed year by year, on notice given 20 days before its expiry.

The Society pays compensation in case of the death of an insured animal from disease or accident, but is not liable where the death of the animal is caused, first, by fire, fall of buildings, flood, war, invasion, riot, or by other forms of violence or crime ; or second, by bad treatment or other fault of the member or of those to whom he entrusts the charge of the animal. It also refuses to pay any compensation when the member has given false information, declines to sell the sick animal when required by the committee, omits to inform the committee without delay when the animal falls ill or meets with an accident, or neglects

to use every endeavour to cure the animal in accordance with the suggestions of the committee.

A member who sells or exchanges an insured animal can substitute for it another insurable animal without additional payment. The committee are required, before accepting an animal for insurance, to have it inspected, and to make sure that it is sound and fairly valued. Insurance is refused when the animal shows symptoms of illness or is in distinctly poor condition, with due regard to its age, or when the owner neglects ordinary sanitary precautions in his treatment of the animal, more especially as regards the condition of the premises in which it is kept, or when the member has already insured the animal with another society.

When a case of anthrax or other contagious disease has occurred in the neighbourhood, the committee may suspend the acceptance of new animals for insurance up to 30 days after the last death from such a disease. The Society has the right to have inspections made of the premises on which the insured animals are kept, and the committee may suspend a member's right to compensation when it finds that he has committed a breach of the conditions of insurance or of elementary rules of sanitation. Whenever any accident happens to the insured animal or the member notices any symptom of illness, he must inform the committee and the inspectors within the succeeding 24 hours. The committee, on receiving such a notice, is required to satisfy itself that the policy has not expired and that there has been no fraudulent substitution of animals; and to decide whether the owner should be required to undertake the cure of the sick animal by adopting any suggestions made by the committee as to the measures to be taken, or to sell it at once; and whether the death, if it has already occurred, can be attributed to fraud or negligence on the part of the member, or to the other causes which exempt the Society from liability. The expenses of the feeding and the cure of the sick animal are at the charge of the member; but the Society may, when its finances allow, make a grant towards these expenses.

Extra Levies.—When during the year the available funds are exhausted, whether owing to extraordinary mortality or other causes, so that they are not sufficient for the payment of the claims, the committee may call upon the members to pay an extra levy not exceeding 7½ per cent. of the ordinary insurance contributions of the year. If this levy does not provide sufficient funds to meet all the liabilities of the Society, a general meeting must be summoned to decide, for the current year, on the adoption of one or both of the following measures: (1) the imposition of a further levy, (2) the reduction of the proportion of the insured value to be paid as compensation. The whole of the profits of each year must be carried to the reserve fund.

Recent Statistics with regard to the Working of the Society.—In 1913 the Society consisted of 336 members and issued 286 policies, covering 587 animals, valued for insurance at £10,552; so that on the average each insurer insures only two animals and the average value of an animal for insurance is £18. On the average of the four years 1910–13, the number of animals insured was 426, and the number of claims paid 18, so that the casualty rate averaged 4·2 per cent. per annum: it varied from 5·7 per cent. in one year to 3·1 per cent. in another. The average age of the animals on which claims were paid was for working bullocks 5¼ years, for cows 5 years, and for calves 12½ months. The amount paid in compensation averaged £209, or £11 12*s.* per animal

on which a claim was allowed, but nearly one-third of this sum was recovered by the sale of the animal or its carcass. When an insured animal dies or falls ill, or meets with an accident, and the committee, on the report of its inspectors, thinks it should be condemned as unfit for work or unlikely to recover, it is examined by a veterinary surgeon, who certifies the disease (if any) from which it is suffering and whether its flesh is fit for human food. If the disease is anthrax, the flesh and hide are destroyed; if pneumonia, tuberculosis or other dangerous disease, the flesh is destroyed and the hide sold; and if the disease is not considered to make the flesh unfit for consumption, for instance, if it is a disease of the limbs, or if the animal has been injured by an accident, it is eithered butchered or sold alive, the proceeds of the sale in every case being credited to the Society. Of the 72 animals on which claims were paid during the four years 1910–13, in 29 cases the flesh was destroyed, in 16 it was sold, and in 27 cases the animal was sold alive. The Society thus receives a considerable income from the sale of condemned animals, which goes to counterbalance to some extent the amount paid on claims. In the three years 1911–13, during which 55 claims were paid, the Society paid in compensation £683, but received for the sale of animals and carcasses £201, so that its net loss was only £482, an average of £8 15*s.* per animal on which compensation was paid. This is equivalent to an average annual net loss of 6*s.* 10*d.* per animal insured during those years. During the same three years the income from premiums amounted to £533, an average of 7*s.* 7*d.* per annum per animal insured; so that, taken by themselves, the income from premiums was more than sufficient to cover the net losses on claims.

The other income and expenditure of the Society are comparatively small, as no contribution is levied for management expenses, and as most of the work of administration is done without remuneration. In 1913 the Society had a windfall in the shape of a prize of £80 awarded it as being one of the best managed societies of the kind in Italy. The averages for the three years 1911–13 have been as follows:—

Average income.	£
Insurance premiums	178
Sale of condemned animals and carcasses	67
Prize from Board	27
Other income	5
Total income	277
Average expenditure.	£
Paid on claims	228
Salaries to clerk and marker	15
Other expenses	20
Total expenditure	263

Thus during these three years the average income exceeded the average expenditure by £14 per annum, and the reserve fund at the end of 1913 showed a credit balance of £34. Had the Society not received its £80 prize in 1913, its working would have resulted in a small net loss, and its balance sheet would have shown a deficit of £46. The working expenses averaged per annum £35, or 1*s.* 6*d.* per animal insured, and if the Society were to levy a separate management contribution of something like this amount it might expect to see its reserve fund increase satisfactorily, even if it did not again obtain outside help in the form of a prize. In England, when the costs of management are accounted for separately, a levy equivalent to 6*d.* per animal per annum is generally found sufficient.

It will be seen that the Society has adopted the principle of charging the insurance contribution at a higher percentage on the more valuable than on the less valuable animals. This would be fair *only if the casualty rate were higher among the better animals than among those of less value*; but, to judge from experience in this country and in India, among cattle owned by peasants, none of them so highly-bred as to be delicate in constitution, the casualty rate among the more valuable cattle is likely to be less than among the less valuable, which are, on the whole, not so well cared for. Besides, this principle acts as a deterrent on the keeping of better-class animals, a practice which ought to be encouraged as much as possible. It would seem to be fairer and wiser therefore if the Society were to charge as premium the same percentage on all animals, whatever be their value.

Another principle adopted by the Society is to charge the same percentage on working bullocks as on breeding and milch cows, and a lower percentage on calves. To judge from the Society's own experience during the four years 1910–13, this also is unfair. Adding together the figures for those years, we have the following result:—

Class of Animal.	No. Insured.	No. of Claims paid.	Casualty rate per cent. per annum.
Working bullocks	522	15	2·9
Cows	552	30	5·4
Calves	628	27	4·3
All animals	1,702	72	4·2

Thus, as a matter of experience, the actual casualty rate among the working bullocks has been little more than half that among the cows. There is a further reason for charging a lower rate on the bullocks. What the Society has to meet in premiums is the net loss after deducting the receipts from sales of condemned animals from the amount paid in compensation, and on this point the following figures are instructive:—

Class of Animal.	Total No. on which Claims were paid.	How disposed of.		
		Sold alive.	Flesh sold.	Flesh destroyed.
Bullocks ..	15	5	3	7
Cows	30	6	9	15
Calves	27	16	4	7
All Animals ..	72	27	16	29

Thus the proportion of condemned animals which were sold alive, and therefore presumably brought a better price than they would have fetched if they had died or been slaughtered, was for bullocks, one third; for cows, only one-fifth; and for calves more than one-half. It seems that, although bullocks are more liable than cows to accidents, diseases

of the limbs, and injury to their health from exposure or over-work, the casualty rate among them is really considerably less than among cows, which are liable to many diseases and especially to those connected with parturition; for instance, during the four years, the number of deaths from anthrax alone was as follows: 2 bullocks, 8 cows and 1 calf. On the whole, it would seem that, to judge from the Society's own recent experience, a fairer system of charging premiums would be as follows:—

Working bullocks	2 per cent.
Cows	4 "
Calves	3 "

on the value at which the animal is insured, whatever that value may be. As the Society pays the owner as compensation only four-fifths of the insured value, these rates should leave sufficient margin to pay the expenses of management; but a better principle would be to charge say one franc (9½*d.*) per animal per annum as a management contribution and to keep the costs of management within that figure, leaving the surplus of the premium income to go to build up a reserve fund, which would protect the Society from the risk of having to make a levy in years of exceptional mortality, and would in time enable it to reduce the rate of premium charged to members of long standing.

Comparison with the Experience and Methods of English Cattle Insurance Societies.—It is interesting to compare the experience of this Italian Society with that of similar co-operative insurance societies in England and Wales. Most of the co-operative cattle insurance societies in this country insure only cows and female calves, and pay compensation in much the same class of cases as is done by the Ferentino Society. They do not however as a rule pay for any animal which can be sold alive; they make the owner do his best to cure the animal, and only pay compensation when it dies or has to be slaughtered as incurable. This may partly account for the higher casualty rate at Ferentino, which, for cows and calves taken together, is 4·8 per cent. per annum, while on the average of nearly 10,000 cows and calves co-operatively insured in this country, the casualty rate is only 2·6 per cent. Probably the main reason for this great difference in casualty experience, however, is that cattle in Italy are much more exposed to epidemic diseases than they are in this country, which has been enabled by its insular position and the general spread of veterinary and sanitary knowledge among the cattle-owning classes to reduce the risk of loss from such diseases to a minimum. Probably no English cow insurance society has, at all events for many years, had any loss comparable to the 11 cases of anthrax which have occured among the 426 cattle insured at Ferentino within the last four years.

Another marked difference is that at Ferentino the Society finds it possible to recover a considerable proportion of the amount paid as compensation by the sale of the condemned animals or of their carcasses, whereas in this country, owing no doubt to more stringent sanitary regulations and to a greater dislike to the consumption of meat suspected of disease, a condemned animal, unless its death was purely accidental, seldom fetches much more than the value of its hide. While the Ferentino Society during the three years 1911–13 paid £683 in claims, it recovered by the sale of the condemned animals and carcasses no less than £201, or nearly one-third of its losses; while in England, so far as our information goes, the proportion so recovered is less than one-tenth. Notwithstanding this advantage, the average annual net loss to the

Ferentino Society has been 6*s.* 10*d.* per animal insured, while in Englar the corresponding figure is about 4*s.* This difference is, however, part accounted for by the fact that at Ferentino a member may insure h cow up to £30, in which case he would get from the Society £24 as com pensation, while in England most societies fix a low maximum, such a £10 or £12, to the amount payable on the death of any animal: but a at Ferentino the average value for insurance of all the animals is onl £18, it seems that most of the members are content with the lowe maximum of £20 for a cow and £12 for a calf (four-fifths payable in cas of death). At Ferentino, on a cow valued at not more than £20, th rate of premium charged is $2\frac{1}{10}$ per cent. on the value for insurance, an as only four-fifths of this value is payable as compensation, this is equiva lent to 2·6 per cent. on the compensation payable; but, according t recent Ferentino experience, this rate is not nearly sufficient to cove the net losses in the case of cows, and should be raised to something lik 4 per cent. On the other hand, in England, according to the experienc of English cow insurance societies, a rate of a little over 2 per cent. o the maximum compensation payable is quite sufficient to cover the ne losses among cows and provide for the building up of a reserve fund.

In England, it is not usual to insure fattening bullocks co-operatively and there are few statistics available to show what is the death-rat from disease or accident among that class of animal, so that the Ferentino experience regarding casualties among working bullocks is interesting and if the statistics could be extended so as to embrace the experienc of a number of Italian societies they would be especially valuable i India and similar countries, where endeavours are being made to intro duce a system of insuring working bullocks. At Ferentino the casualty rate among bullocks of this class has been only 2·9 per cent. as compared with 5·4 per cent. among the cows, and as the working bullock is kept to a greater age and exposed to much greater risks than the fattening bullock, it seems probable that an even greater difference in casualty rates exists between fattening bullocks and cows in this country; and that here, if, as experience proves, a little over 2 per cent. on the amoun of compensation payable is enough to cover the net losses in the case o cows, then about $1\frac{1}{3}$ per cent. should be enough to charge in the case o fattening stock.

Although, to judge from its own recent experience, the rates of pre mium charged by the Ferentino Society require to be raised somewhat and readjusted in fairness to the working bullocks there can be no doubt that it has been most successful in insuring the cattle belonging to its members at small cost to them, and thus has saved many of them fron what would, without it, have been ruinous losses.

OFFICIAL NOTICES AND CIRCULARS.

National Egg Collection for the Wounded.

IN order to meet the requirements of soldiers in our hospitals in France and at home, a supply of 300,000 eggs is needed each week The National Egg Collection for the Wounded is at present securing a weekly supply of about 350,000 eggs, but the need for main taining the figure at this high level is emphasised in a recent circular letter. Egg boxes are also urgently required, and poultry keepers who are willing to assist in providing these are invited to send their boxes, carriage forward, to the Central Depot, Messrs. Harrods, Ltd., Trevor Square, London, S.W.

Delay in Transport of Agricultural Machinery by Rail. Early Purchase of Binder Twine.

ON 15th April the Board of Agriculture and Fisheries gave notice that considerable delays are likely to arise under present conditions in the transport of agricultural machinery by rail, and the attention of farmers was directed to the desirability of making early arrangements for the purchases and repairs of such machinery so as to allow ample time for delivery.

In a further notice issued on 30th April, the Board suggested that farmers should purchase, at an early date, the supplies of binder twine they require, so as to allow ample time for delivery in this case also.

Rabies in an Imported Dog.

ON 17th April the Board of Agriculture and Fisheries notified that Rabies had been certified to have occurred in the case of an imported dog which sickened and died during the period of quarantine prescribed by the Importation of Dogs Order. This dog, which had been brought from Northern Nigeria, showed suspicious symptoms which led to bacteriological investigations being made by the Veterinary Officers of the Board into the cause of death, with the above-mentioned result. Owing to the fact that the conditions of the licence under which the dog was landed required detention and isolation on approved veterinary premises, the affected dog had no opportunity of coming in contact with any other dog in this country.

American Gooseberry Mildew.

THE Board of Agriculture and Fisheries have received information that the summer stage of American Gooseberry Mildew (*Sphærotheca Mors-uvae*) was discovered in a Cambridgeshire garden on the 10th April. All gooseberry growers are advised to examine their bushes carefully, and should any sign of disease be found to spray their bushes with a solution of liver of sulphur (1 lb. to 32 gal. of water). A leaflet describing the disease and giving directions for dealing with it can be obtained from the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W., gratis and post free. Letters so addressed need not be stamped.

Growers are reminded that by Article 3 of the American Gooseberry Mildew Order of 1911 they are required to report the presence of this disease on their premises to the Board or the Clerk of the Local Authority for the district, either directly or through an Inspector, and that the failure to report is punishable by a fine.

Sheep Grazing on Golf Links.

IT has been suggested to the Board by Mr. H. S. Colt, the Acting Secretary of the Sunningdale Golf Club, that many of the golf links in this country might be more extensively employed at the present time for grazing sheep. Mr. Colt points out that, provided the animals are kept under proper control, no undue inconvenience would be caused to the players. The Board recognise that the grazing on a number of links is already used by farmers, but they think that there may still remain a considerable acreage which is not so utilised, and in view of the importance

at the present time of maintaining in the country as large a head of stock as possible, they would suggest that if any Golf Clubs have any land available for the purpose, they should communicate with the local Chamber of Agriculture or Farmers' Union, specifying the approximate acreage of the feed and the terms on which it would be available.

Harvest Weather Forecasts.

THE Meteorological Office will, as in past years, supply forecasts of weather by telegraph to persons desirous of receiving them, upon payment of a registration fee of 1*s.* and the cost of the telegrams, computed at 6*d.* per day. The supply of forecasts commenced on 1st May and will continue until 30th September. The forecasts are drawn up each week-day at 2.30 p.m., and refer to the probable weather during the 15 hours from 6.0 a.m. to 9.0 p.m. on the next day. Forecasts are also prepared at 9.30 a.m. and at 7.0 p.m. to cover the period of 24 hours commencing with noon or midnight next following their issue, and can be sent in lieu of the afternoon forecasts. The addition of a "further outlook" and the issue of notifications in connection with spells of settled weather will be suspended during the war.

Applications for the forecasts should be sent to the Director, Meteorological Office, South Kensington, London, S.W., with a cheque or postal order payable to the Meteorological Committee, to cover the cost of the telegrams for the period, which should not be less than 6 consecutive days, during which the forecasts are to be sent. The telegrams are estimated to consist of 16 words, exclusive of the address.

Agricultural Labour.

THE Agricultural Consultative Committee desire to bring to the notice of farmers the usefnl work which has been done by the Labour Exchanges in providing labour for various industries in connection with which a shortage was found to exist.

Although as a rule this agency has been neglected by agriculturists in the belief that applications addressed to the Exchanges would prove ineffective, upwards of six hundred labourers were supplied for farm work during March and April. All these were not skilled persons, but a number had some experience in milking or other farm work, while the remainder were capable of instruction and provided a means of meeting the deficiency caused by the absence of more skilled labour.

The failure of farmers to make use of this source of supply has given rise to the belief in some quarters that the alleged shortage of agricultural labour does not exist, and that complaints to that effect are due mainly to an unwillingness on the part of farmers to offer an adequate wage.

The Consultative Committee are pleased to think that the latter contention has been disproved by the fact that since the commencement of the war circumstances have in most districts justified an increase in farm wages averaging 15 per cent., in addition to the rise of from 5 to 10 per cent., which took place during the twelve months prior to the war; and they would suggest that if farmers needing labour would register their requirements with the Labour Exchanges, a double advantage would be secured. In the first place their doing so would afford the best possible evidence that the shortage of agricultural

labour was so real and acute that those suffering from it were unwilling to leave any possible source of supply untried; and in the second place, the Consultative Committee believe that were the demand for considerable numbers of men and women thus made clear, the Labour Exchange officials, who are in close touch with Irish and other sources of supply, might do much to find, at any rate, unskilled or partially skilled labour to meet farmers' requirements.

They would, therefore, strongly urge farmers to make known their needs to the Labour Exchanges, either individually or through the local Secretary of the Chamber of Agriculture or Farmers' Union.

The Provision of Labour for Agriculture.*

AT the suggestion of the Board of Agriculture and Fisheries there are being established in a number of counties committees, representing the principal Farmers' Associations, for the purpose of dealing with any existing or anticipated shortage of agricultural labour. Many of these Committees have already met, and are taking steps to ascertain, as far as possible, the nature and extent of the shortage in their districts.

While the main demand for agricultural labour as indicated by the orders received at the Board of Trade Labour Exchanges is at present for skilled men—shepherds, cattlemen, ploughmen, &c., a supply of men of this type from normal sources must be treated as almost non-existent. Some townsmen who have had experience of farm work in their earlier years may possibly be available, but owing to the keen demand for men in town industries, only a small supply can be expected from this source. It is, therefore, important that farmers in need of labour should enquire at the Labour Exchanges with regard to the labour which is actually available and consider to what extent they can utilise such labour as a substitute for that which they employ in normal times. The Board of Agriculture and Fisheries desire to emphasise the fact that farmers must be prepared to use such labour as can be obtained although this may involve the use of types of labour to which they are not accustomed in normal times. The labour available belongs mainly to the following classes:—

(*a*) *Women*.—In some parts of the country, more particularly in Scotland and the North of England, a large proportion of farm work is accomplished by women. The Board of Agriculture and Fisheries are of opinion that during the present crisis it is desirable, if not indeed essential, that the practice of employing women for such branches of farm work as they are capable of doing should be extended. In addition to milking and dairy and poultry work, a large part of the work involved in attendance on cattle and pigs might be entrusted to them, while for potato planting, hoeing and many other branches of field work women would be quite suitable. Farmers would apparently be well advised to utilise as far as possible the labour of women living in the neighbourhood of their farms. Apart from this local source, however, it may be stated that, in connection with the Board of Trade's Scheme of War Service for Women, there were at the beginning of April some 4,000 women registered at the Labour Exchanges as willing to take up agricultural work. Of this number more than 1,500 have had previous experience of the particular type of work which they are now seeking. It may be added that a number of women are now being instructed in

* Statement issued by the Board of Trade.

dairy and light farm work (including milking and attendance on cattle, &c.) in a special demonstration course at various agricultural colleges and schools.

(*b*) *Irish Labourers.*—A considerable number of Irish labourers have already arrived in this country. It is, of course, impossible to make any definite statement in regard to the number who will come over later in the season, but there is apparently no reason to anticipate that the number which *will* come *will* be smaller than in previous years. Arrangements have been made through the Labour Exchanges to facilitate as far as possible the transference of these men to districts where there is employment for them. It must, however, not be expected that in districts other than those in which the employment of Irish labour is customary any considerable supply will be available from this source.

(*c*) *Partially Disabled Soldiers.*—A certain proportion of the men suffering from minor disablements and discharged from the Army as unfit for further military service will be available for farm work. Steps have been taken with a view to securing civil employment for these men as soon as they are fit for it. Many of them will have had some experience of farm work.

(*d*) *Boys.*—The Labour Exchanges are in touch with various authorities which have charge of boys, including the Industrial and Reformatory Schools, and a number of boys will be available for placing in situations on farms or market-gardens. The numbers from this source will, however, probably not be large.

Farmers can ascertain whether it is possible to meet their requirements from any of the above sources by informing the nearest Labour Exchange (of which the address may be obtained at the local Post Office) precisely what labour they need.

THE following statement is communicated to the Press by the Indian Wheat Committee, appointed by the Cabinet Committee on Food Supplies :—

The Export of Indian Wheat.

Arrangements for the regulation by the Government of the export trade in Indian wheat are now nearly completed. The necessity for such regulation has arisen out of the serious rise in the price of wheat in Northern India, in sympathy with the simultaneous rise in other parts of the world. As the price of wheat in India seldom falls below the price in London by appreciably more than the cost of moving the wheat to the United Kingdom, the price which can be obtained for the exportable surplus, although the proportion of this to the total crop fluctuates widely from year to year, governs the price of the wheat consumed in India herself, so long as export is taking place.

In the special circumstances of the violent rise in the world-price of wheat, the Government of India felt it to be against the interests of their wheat-consuming population to permit the continuance of unregulated export. In the absence of regulation there was a likelihood, in spite of expectations of an unusually bountiful harvest, of a level of prices in India scarcely precedented even in times of famine. The explanation of so great an anomaly as widespread distress in the midst of great and obvious plenty, would have been naturally sought in the existence and unregulated continuance of a competitive export trade.

The latest forecast of the crop, which is now being harvested in India, shows an area of 32,148,000 acres under wheat and an estimated yield of 10,293,000 tons, which is in excess of the previous record of

10,061,000 tons harvested in 1911, and compares with 27,697,000 acres and 8,427,000 tons last year. If this forecast is approximately fulfilled, there should be an exportable surplus from the present crop of at least 2,000,000 tons in excess of the normal Indian consumption. To prevent this surplus from finding a market would, on the one hand, have deprived India of a very valuable export in a year in which some of her other staple exports have been unfavourably affected, and have deprived her wheat cultivators of their legitimate expectations of profit, with the result of influencing adversely the area to be sown for wheat in future years; and, on the other hand, it would have deprived the United Kingdom of a source of supply on which, in the present circumstances, she is largely dependent.

The problem which presented itself, therefore, was to place it within the power of the Government of India to effect a divorce between the Indian and the world price of wheat (whenever the conditions of the wheat markets in India and elsewhere may render this advisable), without hindering the shipment to the United Kingdom of India's exportable surplus in such quantities and at such seasons of the year as might have been anticipated in the absence of regulation.

The policy, which has been adopted to this end, is as simple as the conditions of the problem permit. The Government of India have prohibited absolutely the export of wheat from India on private account for the whole period up to 31st March, 1916. The firms ordinarily engaged in the export of wheat from India, to whose willing co-operation and advice the Government are much indebted, have been appointed the agents of Government for the purpose of carrying on the trade under the orders and for the account of the Government of India. The maximum price to be offered by these firms to Indian sellers, instead of being regulated by the price ruling in London, will be determined from time to time by the Government of India and announced on their authority; and, as the season progresses, these maxima will be gradually reduced, so that there can be no inducement to speculate for a rise or to withhold supplies. The maximum price will be the maximum at the port, and firms must only offer up-country such prices as, with the addition of the railway charges, will not exceed this maximum. The necessary variations from the standard maximum will be fixed for the various recognised qualities of Indian wheat.

The working of the scheme in India will be supervised, subject to the orders of the Government of India, by Mr. M. M. S. Gubbay, Indian Civil Service. Supervision in London has been entrusted to the Indian Wheat Committee, which is constituted as follows:—

Lord Lucas (Chairman).
Mr. R. H. Rew (Board of Agriculture and Fisheries).
Mr. F. C. Drake (India Office).
Mr. J. M. Keynes (Treasury).
Mr. A. S. Gaye (Board of Agriculture and Fisheries).
Mr. E. G. Saltmarsh (The Baltic).
Secretary, Mr. H. D. Vigor, 3, St. James' Square.

For the chartering of freight the Indian Wheat Committee have secured the services as broker of Mr. Percy Glanville, of the firm of Messrs. Nelson, Donkin, and Company, who has set up a separate office at Exchange Chambers, St. Mary Axe, E.C., for the transaction of this business, and will devote the whole of his time to it. The firms which bought the wheat in India will sell it in the United Kingdom at market rates, on the London Corn Trade Association Contract or other

customary official contracts. The normal trade channels for marketing wheat in this country will be regularly employed, and the wheat will not be sold at an artificial price. A Committee representative of the agent firms has been set up in London for consultation day by day regarding the sale of the wheat.

Any profit, after payment of all charges, arising out of the difference between the sale of the wheat at its natural price in London and its purchase at the officially regulated price in India, will form part of the revenues of the Government of India. Information as to the method by which funds will be supplied to the firms employed as buying agents in India will be the subject of a subsequent announcement.

Notice to Farmers as to Maximum Production of Crops and Stock, and Especially as Regards Slaughter of Animals.

THE attention of the Board of Agriculture and Fisheries has been *drawn to the fact that the prevailing conditions are causing many* farmers to experience difficulty in maintaining the normal standard of production of their holdings, especially with regard to live stock. The shortage of labour and the increased cost of feeding stuffs, in conjunction with the high prices at which all classes of stock are selling, are tempting a number of farmers to make an immediate profit at the expense of future output and increased returns. Many breeders are marketing their stock before it has arrived at maturity, and several dairy farmers are either reducing or disposing of their herds to an extent that is very much to be regretted.

The slaughter of female animals suitable for breeding is particularly undesirable. The Board possess strong evidence that there is a tendency *to fatten an unusual number of heifers, ewes, and sows, and to send* in-calf cows and in-pig sows to the butcher. This practice, if it should become general, would lead to a serious reduction in the number of flocks and herds in the country.

The shortage of milkers appears to have tended to the dispersion of dairy herds, in part for slaughter, but it might be remembered that the calf is nature's milker, and where no other means are available it may prove a profitable venture to adopt the practice, still common in many pedigree and beef herds, of rearing two or three calves on the same cow, more especially having regard to the high price which store stock is likely to command for some time to come. The Board trust, however, *that the production of milk for market will remain the primary con*sideration, and with that object in view the employment of women milkers might be greatly extended.

The cost of pig feeding may be reduced if store pigs and sows are allowed to run out on grass or on green crops, such as rape, when they will pick up the greater portion of their living. This will not only effect a saving of meal and offals but will also be healthy for the pigs. For fattening pigs, green crops may be fed in conjunction with meal and offals and result in a material saving of purchased food.

By the adoption of expedients of this kind the usual head of stock may be maintained at the minimum cost.

Although an avoidable slaughter of calves is taking place, there is no reason to suppose that it is on a larger scale than usual, and there is evidence to show that in some districts an increased number of calves

is being reared by farmers who are wise enough to look ahead and consider the future situation. In doing so they are taking the right and patriotic course, and one which there is every reason to expect will prove profitable to them.

The Board desire to emphasise the importance of maintaining the flocks and herds of the country at their maximum, and of marketing them only when at their highest economic value. Of the total quantity of meat consumed in this country about three-fifths are usually produced in the United Kingdom, and the withdrawal from the quantity normally imported of the supply required for the Armies must render the civilian population more than ever dependent upon home supplies.

Another matter that has been brought to the notice of the Board is the intention expressed by some farmers to reduce the area of grassland to be mown for hay. Any action of the kind would be most regrettable under present circumstances, when not only have the needs of the farm to be considered, but also the supplies for the Army, which must be maintained at all costs. The Board would therefore impress on farmers the desirability of arranging to retain at least as large an acreage as usual for hay.

The Board feel confident that the agricultural community will do everything in its power to ensure the maximum production of the crops and stock needed for present and future requirements, and although the result may have to be achieved in the face of some difficulties, the Board believe that these difficulties are not insurmountable and that they can rely on farmers to place the interests of the State before all other considerations.

Hay for His Majesty's Forces.

THE attention of the Board of Agriculture and Fisheries has been drawn to the rumours which are being circulated amongst farmers to the effect that the War Office intend to commandeer the stocks of hay in the country at whatever price they may deem reasonable. The Board have reason to suppose that these rumours are giving rise to a feeling of uneasiness in country districts, and, therefore, they think it desirable to publish the actual position of affairs.

It must be remembered, when considering the situation, that the country is at war, and that it is the duty of all good citizens actively to co-operate with the Military Authorities for the purpose of ensuring that supplies required by His Majesty's Forces are punctually delivered.

The hay required for the Army may be divided into two classes—

1. For overseas shipment.
2. For home consumption.

The hay required for shipment must be steam baled and must consist only of good hard hay, such as some clovers, sainfoin or sainfoin mixture, seed mixture, lucerne and upland meadow hay. Landowners and farmers should use every endeavour to render hay of this description available for military purposes. Hay required for the Home Forces may be of a somewhat lower standard, provided that it is clean, sweet and dry.

The average annual production of hay in the United Kingdom for the 10 years 1904 to 1913 was about 14,148,000 tons. The crop in 1914 was much below the average both as regards seeds and meadow

ay, and is estimated to have been not more than 12,400,000 tons. 'ortunately, however, the crop of 1913 was an exceptionally heavy one, stimated at 15,400,000 tons, and the surplus of the latter when added o the 1914 crop brings up the stocks of hay in 1914 to about the verage.

The quantity of hay required by the Military Authorities amounts pproximately to one-fourteenth of the average annual supply. It is vident, therefore, that if the average of production is maintained, the equirements of the Army can be met without any serious interference rith the needs of farmers or of trade and private horse and stock eepers.

It has been decided by the War Office—in order to equalise purchases, nd to prevent hay from being acquired in districts where there may be comparative shortage whilst there is a surplus in others—to make use f the powers vested in the Board of Trade under the Articles of Comnerce (Returns, &c.) Act, 1914, and to require a return to be made of he stocks of hay in the country. The Board feel sure that farmers will ecognise the wisdom of this action and will give it their cordial support.

The War Office hope to obtain all the hay they require by friendly rrangement, but instances may arise in which individuals unreasonably rithhold hay required for the use of His Majesty's Forces. In any uch cases the War Office have decided to use their powers of requisiioning hay under the Army (Supply of Food, Forage and Stores) Act, 914. It is not, and has not been, their intention to use these powers rith the idea of acquiring hay at a price below the fair market value, nd in arriving at the price to be offered for the hay required due regard ill be had to the actual price paid in the immediate neighbourhood or hay of similar class and quality, and to the amount necessary for se on the farm.

The Board would impress on landowners and farmers the very great nportance not only of offering their hay to the Military Authorities, ut also of maintaining and, wherever possible, increasing the acreage o be cut for hay this year.

MISCELLANEOUS NOTES.

Weed Control in Canada.

THE importance of obtaining seeds and feeding stuffs free from weed eds is now well recognised in Canada. The Federal Seed Control Act of 1910 specifies the weeds considered as noxious, and decrees the maximum proportion of such weeds that may be tolerated in farm seeds intended for sowing, while an Order Council, dated May 1st, 1910, provides that bran, middlings and opped fodder must be free from living seeds of the noxious weeds efined under the Seed Control Act.

Weed Control Acts have been in operation in a number of Canadian ovinces for some years, and the experience gained in their working is been found useful in determining the policy most likely to be fective in the future.

The Acts in the different provinces vary considerably in their scope id detail. In Nova Scotia and Quebec, weed legislation is included in ie General Statutes, while in Ontario and Manitoba it forms the subject

of Special Acts. Among the more prominent provisions in force in the various provinces the following may be mentioned. Owners or occupiers of land are made responsible for the suppression of the scheduled weeds on their land. In some provinces they are also made responsible for the roadsides adjoining their land, while in others this duty is apportioned to the Highway Authorities. The railway authorities are bound to observe the provisions of the Acts as far as their land is concerned. Failure to comply with the provisions of the Acts renders the owner of the land liable to a fine or to the refund of the cost of any measures which may be taken to ensure that the provisions are properly carried out.

The administration of such legislation is usually vested in the municipal authorities, who appoint inspectors and superintend the general working of the Acts. In Quebec no inspectors are appointed, but any person can, by special notice, require an owner of land to cut down any recognised noxious weed on his land, and, in case of default, proceedings may be taken and the owner fined. In Manitoba the Act goes so far as to provide for the destruction of a growing crop or the condemnation of land as being unfit for crop purposes where the presence of weeds renders such courses desirable. The Act also provides that threshing machines must be properly cleaned before being removed from one farm to another, and prohibits the depositing of weed seeds on any road, and the sale of screenings from mills or granaries in the province. In the North West Territories, also, an inspector has the power to order the cutting down or ploughing under of a corn crop if noxious weeds are present.

Although the legislation has met with some success, it is now freely admitted that, without the support and co-operation of the farmers themselves, legal restrictions are of little avail. Most of the provinces recognise that the primary consideration is to educate the farmer as to the appearance and habits of growth of the worst weeds, together with the methods of exterminating them. Educational work of this nature is now being provided for in several of the provinces.

In this connection it is interesting to note a novel form of education which has been undertaken by the Ontario Agricultural and Experimental Union. Recognising that there are a number of methods of eradicating the different weeds, the Union arranged during 1912 and 1913 with some 26 farmers to carry out a series of experiments in order to indicate the methods best suited to local conditions. In these two years only four weeds, Perennial Sow Thistle, Twitch Grass, Bladder Campion and Wild Mustard were selected, but it was intended to add other weeds to the experimental list in 1914, and it was hoped that the number of experimenters would be increased.

The subjects of the experiments which were carried out were:

1. The use of rape in the destruction of Perennial Sow Thistle.

2. A system of intensive cropping for the eradication of Perennial Sow Thistle.

3. The use of rape in the destruction of Twitch Grass.

4. A method of cultivation and cropping for the extermination of Twitch Grass.

5. A method of cultivation and cropping for the eradication of Bladder Campion.

6. Spraying with iron sulphate to destroy Wild Mustard in cereal crops.

Not only are these experiments valuable in themselves, but they are of great service as a means of educating the farmers and securing their active co-operation in weed destruction. It is hoped that educational work of this nature, if undertaken throughout the country and combined with suitable legislation, will do much to provide a solution to the weed problem. (*Agricultural Gazette of Canada*, 1914.)

Notes on Crop Prospects Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for April, 1915, contains the following information regarding cereal crops:—

Denmark.—The final figures place the production of wheat in 1914 at 723,000 qr., against 837,000 qr. in 1913, a decrease of 13·5 per cent.; of rye at 1,300,000 qr., against 1,983,000 qr., a decrease of 34·5 per cent.; of barley at 2,729,000 qr., against 3,282,000 qr., a decrease of 16·9 per cent.; and of oats at 4,841,000 qr., against 5,856,000 qr., a decrease of 17·3 per cent.

Argentina.—The preliminary estimate places the production of rye in 1914-15 at 211,000 qr. compared with 390,000 qr. in 1913-14, or a reduction of 45·9 per cent.

India.—The production of wheat in 1914-15 is estimated at 48,020,000 qr., against 39,041,000 qr. in 1913-14, or an increase of 23 per cent., while the area under the crop was greater by 13 per cent.

Condition of Winter Cereals.—The condition of the crops on the 1st April was as follows (100 being taken to represent the prospect of an average crop):—

Wheat.—Denmark 101, Scotland and Ireland 100, Switzerland 90, Lower Egypt 107, Upper Egypt 102.

Rye.—Denmark 104, Switzerland 98. *Barley.*—Switzerland 101, Lower Egypt 99, Upper Egypt 104.

Canada.—Reports received by the Minister of Agriculture from Manitoba, Saskatchewan and Alberta, state that practically all the wheat has now been sown, which is earlier than usual, and that all through the Southern sections, where drought obtained last year, the moisture now in the soil is the heaviest on record.—*Reuter.* (*London Grain, Seed and Oil Reporter*, 29th April).

United States.—The Statistician of the Department of Agriculture, in reporting as to crop conditions on the 1st May, states that the area under winter wheat at that date was 40,169,000 acres, 1,094,000 acres of the total area sown having been abandoned, whilst the area at the same time last year was 36,008,000 acres. The average condition of the crop is estimated at 92·9 per cent., which compares with 88·8 per cent. in April, and 95·9 per cent. a year ago, and the total production is estimated at 693,000,000 bushels as compared with the final estimate of 684,000,000 bushels last year. The condition of winter rye is estimated at 89·8 per cent. against 89·5 per cent. in April, and 93·4 per cent. a year ago. (*Broomhall's Corn Trade News*, 7th May.)

Argentina.—The maize crop of 1914-15 is officially estimated at 8,590,000 tons, as compared with a yield of 6,880,000 tons in the previous year. The area under the crop is 10,380,000 acres. (*London Grain, Seed and Oil Reporter*, 14th April).

The *Review of the River Plate* of 9th April says that after three weeks of comparatively dry weather throughout the cereal zone, very heavy rains fell during the last three days of the previous week. The fall was

exceptionally heavy in some parts of Santa Fé and Cordoba, and caused inundations in the districts of Rufino and Laboulaye through the overflowing of Rivers 4 and 5. The maize crop in the north is giving better results than last year, and from all parts where harvesting is progressing similar reports are to hand.

New Zealand.—According to returns issued by the Government Statistician on the 2nd March, the total estimated yields of the principal crops for the season 1914–15 are as follows:—wheat 615,000 qr. as compared with 654,000 qr. in the previous year, oats 1,274,000 qr. against 1,843,000 qr., and barley 64,000 qr. against 151,000 qr.

Live Stock in Germany.—The preliminary data from the enumeration of 1st December, 1914, place the number of cattle at 21,817,769 against 20,994,344 on the same date in 1913, an increase of 3·9 per cent.; of sheep at 5,448,539 against 5,520,837, a decrease of 1·3 per cent.; and of pigs at 25,339,027 against 25,659,140, a decrease of 1·2 per cent. (*Bulletin of Agricultural and Commercial Statistics*, April, 1915).

Live Stock in Sweden.—The preliminary figures of the number of live stock on the 31st December, 1913, are as follows:—Horses 596,136, against 588,485 on the same date in 1911, or an increase of 1·3 per cent.; cattle 2,720,741, against 2,689,609, an increase of 1·2 per cent.; sheep 988,163, against 945,709, an increase of 4·5 per cent.; pigs 967,684, against 951,164, an increase of 1·7 per cent. (*Bulletin of Agricultural and Commercial Statistics*, April, 1915).

Agricultural Labour in England and Wales during April.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st May, the supply of labour was everywhere scarce during April, but the apprehensions expressed before the heavy spring work commenced were not realised to so great an extent as was feared, partly owing to the fine weather having enabled continuous progress to be made; while in some cases mention was made of the assistance given by women. In a few districts the scarcity was serious enough to interfere with field work.

The following local summaries give further details regarding agricultural labour in the different districts of England and Wales:—

Northumberland, Durham, Cumberland, and Westmorland.—There was a deficiency in the supply of labour in practically every district, but farmers were getting the more important work done. The deficiency appears to be most felt in the north and south-east of Durham and in south Westmorland.

Lancashire and Cheshire.—Though not seriously hampering farm work, labour was deficient throughout the division except in north-east Lancashire, where there appeared to be a sufficiency.

Yorkshire.—The supply of labour was deficient throughout the division, more particularly as regards horsemen and casual labour for potato planting.

Shropshire and Stafford.—The supply of labour was very deficient, and farmers were finding it difficult to keep the work up to date. Casual labour was difficult to obtain, in spite of increased wages.

Derby, Nottingham, Leicester and Rutland.—The supply of labour was very deficient; in some districts wages again advanced, others reported no change. In parts of Nottingham mention was made of the employment of women.

Lincoln and Norfolk.—The supply of labour was generally deficient and wages were still rising in some parts. Casual labour for potato planting was very scarce, but women were employed fairly extensively.

Suffolk, Cambridge, and Huntingdon.—Labour was short; but farmers were adapting themselves to the new conditions, and the supply was just sufficient for present needs. Several increases of 1s. per week in wages were reported from Suffolk.

Bedford, Northampton and Warwick.—There was still a general shortage of labour, but in parts of Bedfordshire and Northamptonshire the scarcity was less marked than in most districts.

Buckingham, Oxford, and Berkshire.—The supply of labour, particularly of casual hands, was deficient, although, on the whole, it did not seem to be so short as expected, and the improved weather enabled work to proceed almost normally.

Worcester, Hereford, and Gloucester.—Labour was deficient throughout the division, except in eastern Herefordshire, where the supply was stated to be somewhat better.

Cornwall, Devon, and Somerset.—The shortage of labour continued, but, owing to the dry weather, was not felt so keenly, particularly in Devon and Cornwall. In Somerset, however, the deficiency was very marked.

Dorset, Wiltshire, and Hampshire.—Labour was everywhere deficient, but most of the important work was being satisfactorily carried out.

Surrey, Kent, and Sussex.—The supply of labour seemed more adequate in Kent than in most parts, and the work on farms was well forward. Complaints of a shortage were general in Surrey, and some parts of Sussex reported a considerable deficiency.

Essex, Hertford, and Middlesex.—In the west of Essex there was a satisfactory supply of women for potato planting, and in the north-west of Essex there was a fair supply of labour except horsemen, but in other districts the supply was deficient.

North Wales.—Labour was very scarce in most places, but in one or two districts in Anglesey, Carnarvon and Merioneth the shortage was not marked.

Mid Wales.—In the south-west of Cardiganshire the supply of labour was sufficient, and in Brecon the shortage was not felt much up to the present, but in other parts of the division there was a decided scarcity of both skilled and casual labour.

South Wales.—There was considerable deficiency in all four counties, both of temporary and permanent labour.

Agricultural Conditions in England and Wales on 1st May.

THE Crop Reporters of the Board, in commenting on agricultural conditions in England and Wales on the 1st May, report that the young corn crops generally look well. The weather was nearly everywhere dry throughout most of the month, but wheat has, upon the whole, rather improved. Good progress was made with the sowing of the spring corn, except on some heavy lands which were too dry to work, and the young plants are satisfactory. Warm rains are now wanted to bring them on.

Potato planting is well advanced in all the more important districts; in some places it is reported that the work has been hindered by the want of sufficient labour. On the whole, this work is probably little more backward than usual. Variable progress has been made with mangold sowing; the seed is going in under favourable conditions, and the progress made is, in most places, about normal for the time of year.

Seeds have everywhere made but little growth, owing to the cool dry weather, and frosts at night have frequently checked them. They are backward but healthy, and in the west and north are a strong plant. Pastnres have been similarly kept back, and are very bare fo: the time of year. Rain is much wanted for all grassland. Live stocl have hardly made much progress during the month, although they are generally healthy, but somewhat backward in condition, the wan of green food being felt. In most cases they have been turned ou later than usual.

Root crops grown for seed in the eastern counties are generally unpromising, owing, it is stated, to the summer last year having beer too dry.

Fruit trees are backward, but there is plenty of blossom, particularly on stone-fruit. Some apprehension is expressed that the night frost towards the end of April may have caused damage, but hardly any i actually reported.

The lambing season has hardly been a good one upon the whole and the mortality, both among ewes and lambs, seems to have bee: at least equal to the average. The reports from the later flocks in th north are scarcely up to those in the south, but in Wales they are mor satisfactory.

Prevalence of Animal Diseases on the Continent.

THE following statement shows tha according to the information in the possessio of the Board on 1st May, 1915, certai diseases of animals existed in the countrie specified :—

Denmark *(month of February).*

Anthrax, Foot-and-Mouth Disease (181 outbreaks), Glanders an Farcy, Swine Erysipelas, Swine Fever.

France *(for the period 4th—17th April).*

Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox.

Holland *(month of March).*

Anthrax, Foot-and-Mouth Disease (46 outbreaks), Foot-ro Glanders, Swine Erysipelas.

Italy *(for the period 12th—18th April).*

Anthrax, Blackleg, Foot-and-Mouth Disease (112 outbreaks Glanders and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosi

Norway *(month of March).*

Anthrax, Blackleg, Swine Fever.

Rumania *(for the period 21st—29th March).*

Anthrax, Glanders and Farcy, Rabies, Sheep-pox, Sheep-scal Swine Fever.

Russia *(month of December).*

Anthrax, Foot-and-Mouth Disease (43,787 animals), Glanders an Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipela Swine Fever.

Spain *(month of February).*

Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden *(month of March).*

Anthrax, Blackleg, Foot-and-Mouth Disease (8 outbreaks), Swin Fever.

Switzerland (for the period March 15th—21st).

Anthrax, Blackleg, Foot-and-Mouth Disease (83 "étables" entailing 1,192 animals, of which 11 "étables" were declared infected during the period), Sheep-scab, Swine Fever.

No further returns have been received in respect of the following countries:—Austria, Belgium, Bulgaria, Germany, Hungary, Montenegro, Serbia.

The Weather in England during April.

District.	Temperature. Daily Mean.	Temperature. Diff. from Average.	Rainfall. Amount.		Rainfall. Diff. from Average.	No. of Days with Rain.	Bright Sunshine. Daily Mean.	Bright Sunshine. Diff. from Average.
Week ending Apr. 3rd:	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours.
England, N.E. ...	39·0	2·8	0·28	7	— 3	3	4·6	—0·1
England, E.	38·1	—3·7	0·20	5	— 4	3	5·9	+1·2
Midland Counties ...	38·4	—4·3	0·24	6	— 4	2	4·4	+0·1
England, S.E.... ...	38·9	—5·1	0·22	6	— 3	2	5·2	+0·4
England, N.W. ...	39·8	—2·8	0·73	18	+ 4	2	5·1	+1·0
England, S.W. ...	38·9	—5·3	0·30	9	— 6	2	5·4	+0·7
English Channel ...	42·2	—4·4	0·16	4	— 8	2	5·3	—0·3
Week ending Apr. 10th:								
England, N.E.... ...	43·9	+1·4	0·09	2	— 8	2	7·3	+2·2
England, E.	45·4	+1·6	0·28	7	— 2	3	6·0	+0·9
Midland Counties ...	44·4	+0·6	0·32	8	— 2	4	6·0	+1·3
England, S.E.... ...	45·9	+0·7	0·63	16	+ 8	4	5·7	+0·7
England, N.W. ...	43·6	—0·1	0·69	18	+ 5	5	6·0	+1·9
England, S.W. ...	45·7	+0·4	0·76	19	+ 5	6	4·4	—0·7
English Channel ...	47·0	—0·6	1·25	32	+21	7	3·8	—2·2
Week ending Apr. 17th:								
England, N.E. ...	45·5	+2·1	0·22	6	— 3	2	4·5	—0·5
England, E.	44·3	—0·3	0·37	10	+ 1	2	4·5	—0·0
Midland Counties ...	45·5	+0·9	0·22	6	— 4	2	4·0	—0·7
England, S.E.... ...	45·0	—0·4	0·34	9	+ 1	2	4·8	—0·4
England, N.W. ...	45·6	+1·0	0·22	5	— 7	4	4·1	—0·6
England S.W. ...	46·8	+0·8	0·12	3	—10	2	3·9	—1·5
English Channel ...	48·1	—0·1	0·16	4	— 7	2	6·5	+0·3
Week ending Apr. 24th:								
England, N.E. ..	44·5	0·0	0·12	3	— 6	2	4·6	—0·4
England, E.	44·7	—2·5	0·05	1	— 8	1	6·9	+1·7
Midland Counties ..	44·4	—1·4	0·14	3	— 7	3	3·4	—1·4
England, S.E.	44·8	—2·2	0·13	4	— 6	2	6·6	+1·3
England, N.W. ...	44·8	—1·0	0·47	12	+ 1	4	4·9	—0·2
England, S.W. ...	45·3	—1·6	0·20	5	— 9	3	4·4	—1·1
English Channel ...	47·4	—1·5	0·21	5	— 7	3	7·2	+0·8
Week ending May 1st:								
England, N.E. ..	47·8	+1·9	0·36	9	0	3	7·6	+2·3
England, E.	49·3	+2·1	0·14	4	— 6	2	6·9	+1·3
Midland Counties ...	50·0	+2·7	0·27	7	— 4	2	7·6	+2·5
England, S.E.... ...	50·1	+1·7	0·06	2	—10	1	7·2	+1·5
England, N.W. ...	49·1	+2·0	0·50	13	0	2	8·0	+2·9
England, S.W. ...	50·6	+2·5	0·17	4	—12	2	7·3	+1·6
English Channel ...	50·1	+0·2	0·29	5	— 8	2	7·0	+0·3

* 1 inch = 25·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	APRIL.		FOUR MONTHS ENDED APRIL.	
	1915.	1914.	1915.	1914.
Anthrax :—				
Outbreaks	59	72	267	315
Animals attacked	69	76	297	337
Foot-and-Mouth Disease :—				
Outbreaks	—	—	—	11
Animals attacked	—	—	—	74
Glanders (including Farcy) : —				
Outbreaks	4	7	11	33
Animals attacked	5	9	16	79
Parasitic Mange :—				
Outbreaks	189	151	*189	1,096
Animals attacked	439	226	*439	1,990
Sheep-Scab :—				
Outbreaks	9	5	143	130
Swine Fever :—				
Outbreaks	327	384	1,275	1,165
Swine Slaughtered as diseased or exposed to infection ...	1,573	4,089	5,546	11,367

* Figures for one month only, the Parasitic Mange Order of 1911 having been suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	APRIL.		FOUR MONTHS ENDED APRIL.	
	1915.	1914.	1915.	1914.
Anthrax :—				
Outbreaks	—	—	1	—
Animals attacked	—	—	1	—
Foot-and-Mouth Disease :—				
Outbreaks	—	14	—	66
Animals attacked	—	110	—	827
Glanders (including Farcy) : —				
Outbreaks	1	—	1	—
Animals attacked	3	—	3	—
Parasitic Mange :—				
Outbreaks	3	10	16	39
Sheep-Scab :—				
Outbreaks	38	23	213	311
Swine Fever :—				
Outbreaks	30	27	95	88
Swine Slaughtered as diseased or exposed to infection ...	159	78	567	395

Unit Prices of Artificial Manures.

Statement of cost to the purchaser of 1 per cent. per ton of *Nitrogen, Soluble and Insoluble Phosphates*, and Potash derived from

	London.	King's Lynn.	Hull.	Newcastle.
	s. d.	s. d.	s. d.	s. d.
Nitrogen from :				
Sulphate of Ammonia pure ... { 95%	14 9	14 0	14 6	14 0
{ 93%	—	14 8	13 9½	13 2
Calcium Cyanamide ...	—	—	12 7	12 3
Nitrate of Soda pure ... ... { 95%	—	—	17 5	
{ 90%	17 5	18 0	17 0	18 0
Nitrate of Lime ...	—	—	—	16 5½
Soluble Phosphates from :				
Superphosphate 35%	2 4	2 0	2 4	2 2½
,, 33%	2 4½	—	2 4½	2 2½
,, 30%	2 5½	2 1½	2 6	2 3½
,, 26%	2 8½	2 3½	2 8½	2 6
Dissolved Bones	3 7½	3 1½	3 3	3 3
Allowed for Nitrogen	*20 0*	*17 3½*	*17 10½*	*17 11*
Allowed for Insol. Phos.	*1 11*	*1 8*	*1 8½*	*1 8½*
Insoluble Phosphates (Citric Soluble) from :				
Basic Slag	1 11	1 11	1 10½	—
Insoluble Phosphates from :				
Basic Slag	—	1 7½	1 3½	1 3½
Bone Meal	1 7½	1 7	1 5½	1 5½
Allowed for Nitrogen	*16 11½*	*16 7*	*15 2*	*15 6½*
Steamed Bone Flour ...	1 6½	1 3	1 7	1 6
Allowed for Nitrogen	*15 10½*	*13 2*	*16 3*	*15 7*
Potash from :				
Kainit	—	—	—	—
Sulphate of Potash ...	—	—	—	
Muriate of Potash ...	—	—	—	—
Potash Salts	—	—	—	—

NOTE.—These unit prices are based on the *probable* retail cash prices in bags f.o.r. for quantities of not less than 2 tons of the manures mentioned at the ports and places specified, but it should be borne in mind that market prices are fluctuating considerably at the present time. The prices are published by the Board of Agriculture and Fisheries for use in comparing the commercial values of artificial manures. They may also be used as a guide to the probable price per ton of any of the manures mentioned if the unit prices of the constituents of the

various sources, at certain ports and Manufacturing Centres, for May, 1915.

Silloth.	Liverpool.	Widnes.	Newport.	Bristol.	Plymouth.
s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
14 0	—	14 3	14 0	—	—
—	14 3	14 5	—	13 10	15 2½
—	—	—	—	—	12 4½
—	16 2½	16 3½	—	—	17 5
17 4	16 4	—	17 6	18 0	—
—	—	—	—	—	—
2 2½	2 2	2 1	2 5½	2 5½	2 5½
2 3½	2 2	2 1	2 6½	2 6½	2 6½
2 3½	2 2½	2 1½	2 7½	2 7½	2 7½
2 6	2 5	2 3½	2 10½	2 10½	2 10½
3 4	3 5½	3 5½	3 9½	3 10	3 10½
18 5	19 2	19 0	20 10½	21 3	21 5½
1 9½	1 10	1 10	2 0	2 0½	2 0½
—	—	—	—	1 11	—
—	1 3½	—	—	—	—
1 8	1 6½	1 6½	1 5	—	1 8½
17 5	16 2	16 3½	14 8½	—	17 8½
1 7	—	—	1 3½	—	1 10½
16 3½	—	—	13 5	—	19 7
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—

manure are multiplied by the percentages of the constituents found in it, and due allowance is made for the difference between cash prices and credit prices, and for cost of carriage from the nearest centre to the place where it is delivered to the purchaser. If used in connection with the valuation of a compound manure regard must be had to the sources of the constituents, and a reasonable sum must be added for mixing, disintegrating and rebagging the ingredients, bags, and loss of weight.

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in April and March, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	April. First Quality.	April. Second Quality.	March. First Quality.	March. Second Quality.
FAT STOCK:—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle:—	s. d.	s. d.	s. d.	s. d.
Polled Scots	11 3	10 6	10 11	10 5
Herefords	11 3	10 2	10 10	9 10
Shorthorns	11 2	10 4	10 9	9 11
Devons	11 4	10 6	11 0	10 0
Welsh Runts	10 11	10 2	10 7	9 7
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	10¾	9¾	11	9¾
Sheep:—				
Downs	11¾	10¼	11½	10½
Longwools	10¾	9¾	11	9¾
Cheviots	12½	11¼	12½	11¼
Blackfaced	12	11¼	11¾	10½
Welsh	12	11	11	10¼
Cross-breds	12	10¾	11½	10½
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs:—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	9 5	8 11	9 0	8 6
Porkers	9 10	9 3	9 4	8 10
LEAN STOCK:—	per head.	per head.	per head.	per head.
Milking Cows:—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	24 5	20 1	24 0	20 2
,, —Calvers ...	23 3	19 4	22 11	18 16
Other Breeds—In Milk ...	22 3	18 4	21 12	18 5
,, —Calvers ...	19 9	16 12	18 4	16 10
Calves for Rearing	2 16	2 3	2 13	2 2
Store Cattle:—				
Shorthorns—Yearlings ...	13 2	11 2	12 13	10 14
,, —Two-year-olds...	17 7	15 4	16 14	14 17
,, —Three-year-olds	22 0	18 5	20 7	18 1
Herefords —Two-year-olds...	19 15	18 1	19 8	17 11
Devons— ,,	18 14	17 2	17 9	15 16
Welsh Runts— ,,	17 3	16 5	16 15	15 9
Store Sheep:—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	58 2	50 9	54 11	47 1
Store Pigs:—				
8 to 12 weeks old	24 1	18 6	21 7	16 0
12 to 16 weeks old	39 8	30 6	37 10	27 10

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in April, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham.		Leeds.		Liverpool.		London.		Manchester.	
		per cwt.		per cwt.		per cwt.		per cwt.		per cwt.	
		s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
BEEF :—											
English	1st	76	6	74	0	—		77	6	76	6
	2nd	71	6	71	0	—		74	0	71	6
Cow and Bull	1st	68	6	67	6	67	6	67	6	70	6
	2nd	62	0	60	6	61	0	63	0	64	6
Irish: Port Killed	1st	74	6	—		76	0	75	0	74	0
	2nd	—		—		70	0	72	0	70	0
Argentine Frozen—											
Hind Quarters	1st	64	0	62	6	63	0	61	0	63	0
Fore ,, ...	1st	60	6	60	6	59	6	57	6	59	6
Argentine Chilled—											
Hind Quarters	1st	70	6	70	6	70	6	71	6	70	6
Fore ,, ...	1st	60	6	61	0	61	0	62	0	61	0
Australian Frozen—											
Hind Quarters	1st	62	0	62	6	60	6	61	0	60	6
Fore ,, ...	1st	58	0	59	6	58	6	58	6	58	6
VEAL :—											
British	1st	83	6	90	6	95	0	87	6	89	0
	2nd	74	6	83	0	87	6	78	0	84	6
Foreign...	1st	—		—		—		88	6	—	
MUTTON :—											
Scotch	1st	94	6	—		104	0	96	0	102	6
	2nd	91	0	—		93	6	90	6	98	0
English...	1st	89	0	92	0	—		91	0	98	0
	2nd	82	0	88	6	—		86	6	92	0
Irish: Port Killed	1st	—		—		91	0	—		93	6
	2nd	—		—		84	0	—		88	6
Argentine Frozen	1st	55	0	55	6	53	6	55	0	53	6
Australian ,, ...	1st	52	0	52	6	50	6	53	6	50	6
New Zealand ,, ...	1st	55	6	58	6	—		59	0	—	
LAMB :—											
British	1st	115	6	112	0	118	0	109	6	119	0
	2nd	106	0	107	6	110	6	100	6	109	6
New Zealand	1st	74	6	77	6	77	0	77	6	77	0
Australian	1st	68	0	67	6	67	6	69	6	67	6
Argentine	1st	68	0	67	6	67	6	69	6	67	6
PORK :—											
British	1st	83	0	76	6	78	6	87	0	77	6
	2nd	77	6	74	0	69	6	81	0	71	6
Foreign...	1st	—		—		—		—		—	

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in April, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Bristol. First Quality.	Bristol. Second Quality.	Liverpool. First Quality.	Liverpool. Second Quality.	London. First Quality.	London. Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	16 6	15 6	—	—	15 6	14 6
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	—	—	137 6	135 6	—	—
„ Factory	—	—	128 0	124 0	—	—
Danish...	—	—	144 6	141 6	143 0	139 6
French...	—	—	—	—	140 0	136 0
Russian	—		—	—	132 0	128 6
Australian	137 6	133 6	137 0	134 6	136 0	132 0
New Zealand	140 6	138 6	140 0	137 6	140 0	136 6
Argentine	136 6	134 6	134 0	131 6	133 0	130 0
CHEESE:—						
British—						
Cheddar	102 0	99 0	103 6	101 0	104 6	99 0
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	93 6*	88 6*	107 0	102 6
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	98 0	96 6	96 0	95 0	98 0	94 0
BACON:—						
Irish (Green)	91 6	87 6	90 0	87 6	90 0	86 0
Canadian (Green sides)	77 6	73 6	77 0	71 0	78 0	73 6
HAMS:—						
York (Dried or Smoked)	116 0	114 0	—	—	116 0	110 0
Irish (Dried or Smoked)	—	—	—	—	107 0	100 6
American (Green) (long cut)	66 0	62 0	64 6	61 0	67 0	62 6
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British...	10 2	9 4	—	—	11 8	10 10
Irish	10 7	10 1	10 5	9 10	11 7	11 1
Danish...	—	—	—	—	12 9	11 7
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
Edward VII.	109 0	95 0	86 6	—	101 6	91 0
Langworthy	100 0	90 0	100 0	95 0	106 0	100 0
Up-to-Date	102 6	87 6	81 6	78 6	106 0	94 0
HAY:—						
Clover	—	—	123 6	98 6	106 6	97 0
Meadow	—	—	—	—	97 6	88 0

* New.

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (in 1915).	WHEAT.						BARLEY.						OATS.					
	1913.		1914.		1915.		1913.		1914.		1915		1913		1914.		1915.	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Jan. 2...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
,, 9...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
,, 16...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
,, 23...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
,, 30...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
,, 13...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
,, 20...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
,, 27...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
,, 13...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
,, 20...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
,, 27...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3...	31	4	31	6	54	6	27	0	25	6	31	9	19	2	18	5	30	6
,, 10...	31	3	31	5	54	9	27	8	26	8	31	3	19	2	18	4	30	4
,, 17...	31	6	31	7	55	4	26	11	25	4	30	10	18	10	18	4	30	5
,, 24...	31	8	31	9	56	5	26	7	26	6	31	5	19	3	18	5	30	11
May 1...	32	2	31	9	58	3	25	11	26	0	32	7	19	6	18	5	31	5
,, 8...	32	6	32	2			25	9	25	6			19	6	18	9		
,, 15...	32	10	32	7			25	4	26	3			19	9	18	11		
,, 22...	32	10	33	0			25	3	25	10			19	11	19	0		
,, 29...	32	7	33	9			26	1	26	1			20	1	19	4		
June 5...	32	10	34	0			26	2	25	11			19	8	19	4		
,, 12...	32	8	34	1			24	7	24	11			20	2	19	8		
,, 19...	32	8	34	1			23	10	25	10			19	8	19	9		
,, 26...	32	8	34	3			24	3	25	4			19	1	20	0		
July 3...	33	1	34	4			25	2	24	6			21	0	19	9		
,, 10...	33	4	34	2			25	10	24	9			19	4	20	0		
,, 17...	33	6	34	1			24	9	24	2			20	5	19	10		
,, 24...	33	10	34	0			24	1	24	7			20	8	19	9		
,, 31...	34	1	34	2			24	5	25	9			20	3	19	8		
Aug. 7...	34	1	34	9			24	9	25	2			19	0	19	1		
,, 14...	34	3	40	3			24	7	29	4			18	7	25	1		
,, 21...	33	7	38	9			26	5	29	10			18	8	24	3		
,, 28...	32	7	36	2			29	0	30	3			17	10	23	5		
Sept. 4...	31	11	36	5			30	11	30	6			17	8	23	9		
,, 11...	31	9	37	10			31	5	29	11			18	0	23	11		
,, 18...	31	7	38	3			30	9	29	5			17	11	23	8		
,, 25...	31	6	37	6			30	1	29	3			17	9	23	3		
Oct. 2...	31	3	37	1			29	9	29	1			17	10	22	9		
,, 9...	31	0	36	8			29	1	28	10			17	10	22	5		
,, 16...	30	11	36	7			28	8	28	8			17	9	22	4		
,, 23...	30	7	37	2			28	7	28	7			18	0	22	5		
,, 30...	30	1	37	10			28	2	28	3			17	9	23	7		
Nov. 6...	30	0	38	8			28	1	28	6			17	9	23	7		
,, 13...	30	1	39	8			27	8	29	0			17	11	24	8		
,, 20...	30	4	41	0			27	5	29	8			18	1	25	5		
,, 27...	30	9	41	11			27	0	30	3			18	4	25	8		
Dec. 4...	31	2	42	2			26	8	30	2			18	4	25	9		
,, 11...	31	2	42	1			26	5	29	11			18	6	25	9		
,, 18...	31	2	42	7			25	11	29	8			18	5	25	9		
,, 25...	31	0	43	3			25	10	29	9			18	4	25	11		

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of April, 1914 and 1915.

	Wheat.		Barley.		Oats.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
London	32 5	56 11	25 4	32 9	19 10	32 2
Norwich	31 3	54 7	25 2	30 5	17 10	30 6
Peterborough	31 0	55 8	26 0	30 3	18 6	30 11
Lincoln	31 11	56 5	25 9	30 10	18 10	30 8
Doncaster	31 5	54 11	25 5	30 0	18 5	29 3
Salisbury	30 6	53 8	23 10	31 11	17 11	31 7

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous—

Agriculture in Russia (Estate Mag., February, 1915). [63(47).]

The Atmosphere of the Soil: its Composition and the Causes of Variation, *E. J. Russell* and *A. Appleyard.* [63.11(04).] Studies on Soil Protozoa *A. Cunningham.* [63.115.] Studies on the Lime Requirements of certain Soils, *H. B. Hutchinson* and *K. MacLennan.* [63.15.] Notes on some Methods for the Examination of Soil Protozoa, *C. H. Martin* and *K. R. Lewin.* [63.115.] (Jour. Agric. Sci., Vol. VII., Part 1, March, 1915.)

Field Crops—

Improvement of the Flax Crop by Propagation from Selected Plants, *H. Hunter* (Dept. Agric. and Tech. Instr. Ireland Jour., January, 1915.) [63.34111.]

Willow Growing for Basket Making and Cricket Bat Manufacture, *W. P. Ellmore* (Estate Mag., February, 1915.) [63.3412.]

Oil Content of Seed as Affected by the Nutrition of the Plant, *W. W. Garner* and others (Jour. Agric. Research [U.S.A.] Vol. III. No. 3, December, 1914.) [63.342.]

Some Considerations affecting the Growing of Linseed as a Farm Crop in England. I. Variations in the Oil Content, *J. V. Eyre* and *E. A. Fisher.* (Jour. Agric. Sci., Vol. VII., Part 1, March, 1915.) [63.342.]

Wheat Breeding, *A. E. V. Richardson.* (Jour. of Heredity, March, 1915.) [63.311.]

The Industrial Position of Copra, Coconut Oil, and Coconut Cake. (Bull. Imp. Inst., Vol. XII., No. 4, October-December, 1914.) [63.342.]

Plant Diseases—

The Pea Thrips (*Kakothrips robustus*). *C. B. Williams.* [63.27.] The Apple Sucker (*Psylla mali*), with Notes on the Pear Sucker (*Psylla pyricola*), *P. R. Awati.* [63.27.] Insecticides, *H. M. Lefroy.* [63.295.] *Infection and Immunity Studies of the Apple and Pear Scab Fungi* (*Venturia inaequalis* and *V. pirina*), *S. P. Wiltshire.* [63.24.] Winter Cover Washes, *A. H. Lees.* [63.294.] (Ann. Appl. Biology, Vol. I., No. 3 and 4, January, 1915.)

Oxidases in Healthy and in Curly-Dwarf Potatoes, *H. H. Bunzel.* (Jour. Agric. Research, [U.S.A.] Vol. II., No. 5, August, 1914.) [63.21.]

Birds as Carriers of the Chestnut-Blight Fungus (*Endothia parasitica*), *F. D. Heald.* and *R. A. Studhalter.* (Jour. Agric. Research [U.S.A.] Vol. II., No. 6, September, 1914.) [63.24.]

A Fungous Disease (*Botryosphaeria marconii*) of Hemp, *V. K. Charles* and *A. E. Jenkins*. (Jour. Agric. Research [U.S.A.] Vol. III., No. 1, October, 1914.) [63.27.]

Apple Root Borer (*Saperda candida*, Fab), *F. E. Brooks*. (Jour. Agric. Research [U.S.A.] Vol. III., No. 2, November, 1914.) [63.27.]

Life History of the Melon Fly (*Bactrocera cucurbitae*, Coq), *E. A. Back* and *C. E. Pemberton* (Jour. Agric. Research [U.S.A.] Vol. III., No. 3, December, 1914.) [63.27.]

Observations on the Life History of *Agrilus Bilineatus*, *R. N. Chapman*. (Jour. Agric. Research [U.S.A.], Vol. III., No. 4, January, 1915.) [63.27.]

Life History of the Mediterranean Fruit Fly (*Ceratitis capitata*, Wied) from the standpoint of Parasitic Introduction, *E. A. Back* and *C. E. Pemberton*. [63.27.] Two Clover Aphids, *E. M. Patch*. [63.27.] (Jour. Agric. Research [U.S.A.], Vol. III., No. 5, February, 1915.)

Veterinary Science—

Warble Flies: A Further Contribution on the Biology of *Hypoderma lineatum* and *Hypoderma bovis*, *S. Hadwen*. [619.2(*f*).] Observations on the Biology of Ixodidae. Part II., *G. H. F. Nuttall*. [59.169(*b*).] (Parasitology, Vol. 7, No. 4, March, 1915.)

Observations upon the Tuberculin Test as applied to Bovine Animals, *F. C. Mason*. (Dept. Agric. and Tech. Instr. Ireland Jour., January, 1915.) [614.5.]

Forestry—

Production and Value of Irish Timber, *A. C. Forbes*. (Dept. Agric. and Tech. Instr. Ireland Jour., January, 1915.) [63.49(415.)]

The Utilisation of Saw Mill Waste, *R. Thelen*. (Estate Mag., February, 1915.) [63.49-197.]

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

Bolton, E. R., and *Revis, C.*—Fatty Foods: Their Practical Examination: A Handbook for Analytical and Technical Chemists. (371 pp.) London: J. & A. Churchill. [543.1.]

U.S. Department of Agriculture.—Bull. 143:—The Production and Fertilizer Value of Citric-Soluble Phosphoric Acid and Potash. (12 pp.) 1914. [63.1672; 63.1673.] Bull. 144:—The Manufacture of Acid Phosphate. (28 pp. + V. plates.) 1914. [63.1672.] Bull. 149:—The Use of Radioactive Substances as Fertilizers. (14 pp.) 1914. [63.168.] Bull. 158:—The Nitrogen of Processed Fertilizers. (24 pp.) 1914. [63.168.] Bull. 164:—Field Test with a Toxic Soil Constituent; Vanilin. (9 pp. + III. plates.) 1915. [63.113] Washington.

Armstrong College, Agricultural Dept.—Bull. 11:—Manuring of Farm Crops, with Special Reference to the Spring of 1915. (8 pp.) Newcastle-on-Tyne. [1915.] [63.16(04).]

Russell, E. J.—Soil Conditions and Plant Growth. (190 pp.) [New Edition.] London: Longmans, Green & Co., 1915. 5*s*. net. [63.113; 63.161.]

Orwin, C. S.—The Farmer in War-Time. (20 pp.) [Oxford Pamphlets, 1914–1915.] London: Oxford University Press [1915]. 2*d*. net. [63(42).]

Canada, Department of Agriculture.—Agricultural War-Book: Patriotism and Production more than usual. (157 pp.) Ottawa, 1915. [63(71).]

Horticulture—

U.S. Department of Agriculture.—Farmers' Bull. 643:—Blackberry Culture. (13 pp.) Washington, 1915. [63.41(*c*).]

Massachusetts Agricultural Experiment Station.—Bull. 159:—The Technical Description of Apples. (73–90 pp.) Amherst, Mass., 1914. [63.41(*a*).]

Oregon Agricultural Experiment Station.—Bull. 123:—An Inquiry into the Nature of a Somatic Segregation of Characters in the Le Conte Pear. (16 pp.) Corvallis, Oregon, 1914. [63.41(*a*).]

Plant Diseases—

Vermont Agricultural Experiment Station.—Bull. 168 :—Investigations of the Potato Fungus *Phytophthora Infestans.* (100 pp. + X. plates.) Burlington, Vt., 1912. [63.24.]

Ontario Department of Agriculture.—Bull. 227 :—Cherry Fruit Flies. (30 pp.) Toronto, 1915. [63.27.]

U.S. Department of Agriculture.—Bull. 160 :—Cactus Solution as an Adhesive in Arsenical Sprays for Insects. (20 pp.) 1915. [63.295.] Bull. 161 :—The Mediterranean Fruit Fly (*Ceratitis capitata,* Wied.) in Bermuda. (8 pp.) 1914. [63.27.] Bull. 165 :—Quassiin as a Contact Insecticide. (8 pp.) [63.295.] 1914. Bull. 167 :—Para-Dichlorobenzene as an Insect Fumigant. (7 pp. + II. plates.) [63.294.] 1915. Bull. 170 :—The European Pine-Shoot Moth (*Evetria buoliana* Schiffermiller) ; A Serious Menace to Pine Timber in America. (11 pp. + VI. plates.) 1915. [63.27.] Washington.

Washington Agricultural Experiment Station.—Bull. 115 :—Studies on the Relation of Certain Species of Fusarium to the Tomato Blight of the Pacific North West. (22 pp. + IV. plates.) Pullman, Washington, 1914. [63.24.]

Live Stock—

Sanders, A. H.—The Story of the Herefords. (1,079 pp.) Chicago: The Breeders' Gazette, 1914. $3.50. [63.62.]

Pease, Sir A.—Horse Breeding in Relation to National Requirements. (42 pp.) [Journal Farmers' Club, February, 1915.] London : Farmers' Club, 1915. 6*d.* [63.61.]

North Carolina Agricultural Experiment Station.—Bull. 223 :—Sheep Raising. (30 pp.) Raleigh, N.C., 1912. [63.63(04).]

Wisconsin Agricultural Experiment Station.—Circ. 53 :—Judging Draft Horses. (36 pp.) Madison, Wisconsin, 1914. [63.6(064).]

Frost, J. A.—The Shire Horse in Peace and War. (132 pp.) London : Vinton & Co., 1915. 2*s.* net. [63.61(02).]

Harper, M. W.—Breeding of Farm Animals. (335 pp.) New York : Orange Judd Co., 1911. $1.50. [63.603.]

Ohio Agricultural Experiment Station.—Bull. 271 :—A Chemical Study of the Nutrition of Swine. (225–261 pp.) Wooster, Ohio, 1914. [63.64.]

Dairying and Food, General—

Michigan Agricultural Experiment Station.—Special Bull. 1 :—Studies in the Range of Variation of the Per Cent. of Butter Fat in the Milk of Individual Cows. (13 pp.) East Lansing, Mich., 1914. [63.712.]

Lancashire Education Committee.—*Farmers' Bull. 28 :—Report of an* Experiment on the Feeding of Dairy Cows. (14 pp.) Preston, 1915. [63.711.]

U.S. Department of Agriculture.—Bull. 98 :—The Application of Refrigeration to the Handling of Milk. (88 pp.) Washington, 1914. [63.713.]

U.S. Department of Agriculture.—Farmers' Bull. 602 :—Production of Clean Milk. (18 pp.) 1914. [63.71(04).] Farmer's Bull. 608 :—Removal of Garlic Flavour from Milk and Cream. (4 pp.) 1914. [63.71(04).] Farmers' Bull. 623 :—Ice Houses and the Use of Ice on the Dairy Farm. (24 pp.) [63.713.] Washington, 1915.

East Sussex Education Committee.—Food Cost of Winter Milk. (19 pp.) 1914. [63.711 ; 63.714.]

U.S. Department of Agriculture.—Bull. 177 :—The Production and Consumption of Dairy Products. (19 pp.) Washington, 1915. [63.7(73).]

Bibby, J., and Sons.—Bibby's Book on Milk : Section II.—The Law relating to the Sale of Milk : Its History, Criticism of its Administration and *Suggestions for its Amendment. [4th Edition.] (256 pp.) Liverpool :* J. Bibby & Sons, 1914. 4*s.* net ; Clothboards. 5*s* [614.32.]

Macdonald College, Quebec.—The Milk Supply of Montreal : A Report of a Bacteriological Investigation of the City's Milk Supply. (68 pp.) Quebec, 1914. [614.32 ; 63.7(71).]

(3838.) Wt. P. 16—9. 7450. 5/15. J. T. & S., Ltd.

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 3.

JUNE, 1915.

SUGGESTIONS FROM AMERICA FOR CO-OPERATIVE SELLING.

A. W. ASHBY.

ALTHOUGH agriculture is one of Britain's greatest industries, there is room for considerable improvement in the methods followed in marketing certain classes of agricultural produce. Many farmers, while devoting great energy and ingenuity to production, have left the art of selling to a large extent undeveloped.

The greatest difficulties in the way of efficient marketing of home-grown farm produce have been lack of standardisation, rough methods of packing, and absence of association in the public mind between a name and a standard of quality. With regard to certain kinds of produce, especially dairy produce, which go through a factory, these faults have already been remedied by enterprising firms.

Where no system of standardisation exists dealers must examine each case of goods offered for sale ; and after the purchase of a number of small quantities, each of a slightly different standard, it is difficult to make up a large quantity of uniform quality to offer to large purchasers. Farm butter bought in small quantities is often blended and re-made by wholesalers, or re-formed by the Scotch-hands in the retailer's shop. Reliability of the quality of products is one of the most important factors in the stability of any business.

The necessity for an improvement in the methods of packing should need no further advocacy when it is remembered that fruit often suffers in transit to the extent of twenty per cent. of its value.

From individual farms which are properly equipped and ıanaged many products could be sent out with a guarantee of uality and bearing a distinctive label. If milk, cream, butter nd eggs are supplied direct from a farm to suburban customers, ıe farmer himself, or a member of the family, must take charge f the selling and advertising department; but where the roducers are not located near the consuming market little ın be done without a Producers' Association. Such an ssociation need not interfere with the production on individual ırms, but should simply supervise the grading, packing, nd advertising for a group of individuals. The internal onomy of each constituent farm may remain unchanged, nd yet the market status of the commodities produced in ny neighbourhood may be raised considerably. For example, ıis would be comparatively easy in a neighbourhood where particular kind of cheese is made.

Examples of Successful Associations.—(1) In America farmers ave begun to realise the value of grading and branding products. 'or example, an agricultural association in Milwaukee County as recently decided to mark with the association's label all roducts put on the markets by its members. This means that ıe products have been tested and have come up to a certain andard. Individual farmers have been using brands for ıeir produce in other localities besides the "middle-west." rban firms which deal in the products of the farm long nce adopted standards and labels for their goods. In ll American cities there is a large trade in milk and bottled ream; and the local farmers supplying milk in town are bliged to follow the methods adopted by their energetic vals. In English towns there should be an immense trade or this class of produce, especially when the produce is supplied irect from the farm with the suggestion of the country in oth the goods and the label. The trade only requires be initiated by a few enterprising farmers.

(2) *The Californian Fruit Growers' Exchange* furnishes ıother example of American enterprise in co-operative lling. This Exchange, which is one of the most effective rmers' co-operative societies in the world, does not produce uit, nor does it buy from the farmer or sell to the shopkeeper. he growers form small community organisations. These odies usually own small packing houses alongside a railway, here the members' fruit is collected, graded, pooled, packed ıd prepared for transport, these operations being done at a ost pro-rated on the number of boxes consigned by each grower.

Occasionally the association handles the fruit of each member separately. No profits are accumulated and no dividends are declared. The small community organisations are federated into Districts with a federal organisation known as a District Exchange. The function of the District Exchange is to act as a clearing house in co-operation with the associations through the facilities provided by the Fruit Growers' Exchange. Its duty is to order railway wagons and see that they are placed by the railway companies at various packing houses, to keep a record of the wagons despatched by each association, to place information before the local associations, to receive the returns for the fruit from the central Exchange, and to distribute the proceeds among the associations. The central Exchange is managed by a General Manager and one representative from each District. Its function is to furnish the marketing facilities for the District Exchanges at a *pro rata* cost.

Under the direction of the General Manager, agents are posted in many of the large distributing centres in the United States and some other countries. These send in daily reports on the state of the market, and order such supplies as they can sell. As soon as these orders are received they are distributed among the District Exchanges, and the fruit is despatched direct from the farmer to the local agent or to the purchaser. The agent acts directly under the order of the consignors, and the farmer is charged a commission on the sales made. Neither the District nor the Central Exchanges make any profit.

In this way the market is almost perfectly organised. Wherever there is a demand it is met as long as there is an available supply. The quality of the fruit is known by distributors because it is properly graded, packed and labelled by the local association, yet it remains the farmer's property till it reaches its ultimate destination. There is no leakage of profits between the farmer and the retailer.

A modification of this method of organisation might be applied by our English cheese-makers, and the prime products of Cheshire, Somersetshire, or Wensleydale could be much more widely distributed in England than they are at present. When English cheeses are selling quite cheaply in some districts it is almost impossible to buy them in others, because the necessary channels of distribution do not exist.

American conditions are different from those existing in England, but the difference is chiefly one of degree. Whenever produce has to be sold outside a small local area it must be

collected in large quantities for purposes of transportation. For sale in bulk standardisation is necessary. It makes no essential difference whether the distance between the place of production and the consumer's market is fifty or a thousand miles. Unless farmers take steps to organise and grade the supply of their products some kind of middleman will do so. Associations of farmers can do this much more cheaply and efficiently than middlemen, because the necessary grading and packing would be carried out at an earlier stage than is possible when the produce has to be sold from the farm before these processes can be attempted. Excluding the District and Central Exchanges, necessitated by a large volume of business, the system of the Californian Fruit Growers' local association for grading, packing, organising truck loads, and appointing agents, might be adopted by some English farmers—amongst others, fruit growers and cheese-makers. Such an association should be run on a non-profit basis, charges being made on the cost of processes and commissions for agents.

(3) Little development has taken place in the marketing of home-grown fruit in England during the last few years, although the sale of fruit has increased enormously; but in some districts improvements have been made, and the following example of a successful individual effort shows that there is scope for enterprising people who are willing to sell services as well as bare commodities.

In Lancashire a tenant of about 120 acres of farm garden land has about 30 acres under apples and rhubarb. Some years ago he had trouble in disposing of his apples at a satisfactory profit, and therefore changed his methods. Instead of packing apples of all sizes in "pots" of 64 lb. as before, he grades them according to size in boxes containing 24 lb. each. These are sold in the ordinary way on the Liverpool Produce Market. A load of apples is gathered straight from the trees, graded in boxes as they are picked, weighed and placed on the wagon. Next day the carter takes them into the market and stands there to sell one box or one hundred boxes to any customer who will pay the prevailing price of the day for the quality he offers. The bargain is made between the carter and the customer, and these apples generally make a price above the average. The reason why 24 lb. was adopted as the standard size for the boxes was twofold. As each farthing per pound is equal to sixpence per box it is not difficult for the carter to compute the price of any number of boxes; and 24 lb. is not too small for the retail dealer to handle nor too large for the private consumer. When apples which are not fit for immediate

use are sold—as they often are—the name of the variety and the month of ripening appear upon the ticket. All varieties except such common ones as "Blenheims" are named.

The boxes are made by the farm labourers during wet weather, generally during the winter, so long as storage room is available. The wood is bought in Norway, cut to a standard size, and comes bound in wire, a dozen ends, a dozen bottoms and so on. An ordinary bench, a simple arrangement of a plank with two slits to hold the ends while the first side is being nailed, a hammer and nails complete the outfit. Round the top of the box is nailed a strip of wood 1 inch by ¼ inch to form a rim, so that when the boxes are loaded on the wagon there is no possibility of their falling off, and no need of roping, because each box fits into the one below it, and the apples are not bruised. There is no worry about the return of hampers, and the boxes are always clean and are cheaper. A little capital is necessary to buy the wood in sufficient quantity to order the cuts to make a standard box without further trouble, but the expense is gradually recovered. Even with hampers which may normally be expected to last several years there is continual loss. Though a few hampers from amongst a certain purchase may remain in stock for several years, experience proves that practically a new supply is needed as each fruit season comes round.

If this method of marketing fruit were adopted, the boxes might also be used for retailing potatoes, especially selected tubers for roasting. Otherwise potatoes might be marketed in small sacks of about 28 lb. or 56 lb. in which form they are easy to handle and are suitable either for the retailer's shop or the consumer's cellar.

Suggestions for Packing, Marking, &c.—In America, strawberries are packed by the quart in shallow "chip" boxes with a rimmed bottom which are then placed in a light case, sixteen boxes to the case.

When butter is produced in fairly large quantities, that too should be packed in light wooden cases. Any up-to-date saw mill would supply the white deal boards cut to standard sizes, and the boxes can be nailed together quite easily. To be sent to the market or shops, butter should be packed in boxes of two or four dozen pounds. Each pound of butter should be packed as a brick in stiff, grease-proof paper. If a farm or association brand is used, each end should be sealed with the gummed stamp. When sold retail the butter should always be packed in cartons. These can be bought quite cheaply and in them the butter can

be carried in the milk float in an open box or basket in the handiest possible form, being kept perfectly clean and cool and in good shape. The makers will print a farm or association brand on the cartons as may be desired.

Standardisation and the guarantee of quality are more important than the label. In the case of a society of producers carrying out the later processes together in one building, it is quite easy to grade, standardise and label the goods. Even where all the processes are carried out on individual farms it should not be difficult. If a group of cheese-makers formed an association, collected a subscription according to acreage or to the number of cows kept, and drew up rules stating the minimum standard of cleanliness and equipment of cows, sheds, and cheese-room, it could then employ a competent judge of cheese to inspect and label the products of each farm.

This system of inspection and marking could be pursued also in the case of butter, providing rules were enacted that the cows, sheds, and dairy equipment were of a given standard, and that the marker had power to inspect these and make reports. The right to refuse to brand an article must always be given to the society's inspector, with a provision for immediate appeal to one or two other persons who should be nominated for the purpose.

It is a very debatable question whether eggs should be marked at all, unless they are supplied direct from farm to consumer. If they are branded with the name of a farm, and a dealer happens to supply a customer with eggs he has kept too long, the customer avoids the branded egg for the future. For obvious reasons dealers object to eggs which are branded with the date when laid. In selling direct to customers, however, these considerations need not be entertained. When sending butter and eggs to a produce market it is well to have the boxes or crates distinctly marked with the brand of the farm. If the dealers are sure of the origin of the goods the price is likely to be a good deal better than if they are not.

The Use of Brands.—The brand should be just the visualised expression of the quality of the goods it covers. In the case of a group of cheese-makers something distinctive of the locality might well form the design for the brand.

For Cheddar cheese the Cheddar rock might be depicted in strong clear outlines, and a short name for the society with a motto of two or three words might be added. It is essential that the name of the society be short, and not clumsy or ugly. The

motto also should be pointed and should refer directly to the article it is to distinguish. A design which might be used by a group of meat or other producers is shown in Fig. 1.

The items of chief importance about the design for a label are that it should be small, and "strong" or distinctive. It should never be complicated or over-loaded. In choosing a design the judgment of the women of the farm should be relied upon; as women are the chief purchasers of farm produce their likes and dislikes must be studied if they are to be attracted. In many cases the wife or daughter of a farmer is quite capable of designing a brand for farm products.

FIG. 1.—Design for a label for a group of meat producers.

The design may be used in two forms: as a die for printing, and as a rubber stamp. For butter, small cheeses, honey and preserves it should take the form of a printed stamp with a gummed back. For milk or cream bottled by machine the brand should be printed on the cardboard stoppers before they are sent out from the factory. Where a brand is used for a number of commodities the colour of the ink should be varied, *e.g.*, black for milk and red for cream.

Types of brands are shown in Figs. 3 and 4.

So far none of the fancy methods of marketing, such as the parcel post, or the "family hamper" have been mentioned. Nothing has been suggested save improvements in the ordinary methods of marketing fruit and dairy products, in which direction there is more to be done and more profit to be obtained than in developing costly and uneconomical methods of direct supply. The main suggestions are for the grading, standardising and advertisement of products.

Advertising.—Municipalities have long recognised the value

of advertising, and if rural communities have capital to spare they might well follow this example.

"Ensure and advertise quality" should be the farm salesman's motto, and wherever possible a group of producers or a community should advertise. They should attempt to secure a national reputation for the production of an article for the neighbourhood. This can be done in regard to more than the small products of the farm. Waukesha county in the State of Wisconsin is known as "the Guernsey Island of America,"

FIG. 2.—American method for securing a national reputation for the produce of a small locality.

and is said to contain more pedigree cattle of this breed than the island of Guernsey itself. Some years ago, before the demand for improved dairy cattle became prevalent in the United States, a Guernsey Breeders' Association was formed in the county, and consignments of stock were bought in Guernsey. Since then the Association has bred, selected, tested and advertised, till the neighbourhood has gained a

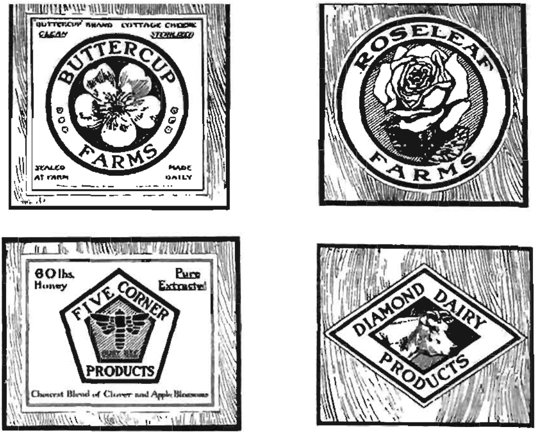


FIG. 3.—Specimens of American Brands.

continental reputation. Each year the Association publishes special and general advertisements. Members participating in special advertisements are specially levied, otherwise each member is levied for the general advertisements according to the number of animals he sells. In the general advertisements no sales list is published, but the president is supplied at intervals with a list of the animals offered for sale by members, and when enquiries are made, as they continually are, prospective purchasers are directed to the people who can supply their needs. By advertising in national papers, purchasers are brought from all over a continent to a little county in a State which itself is about the size of England. If the farmers of some locality in England would pursue a similar policy with regard to dairy shorthorns at the present moment it would undoubtedly result in great prosperity for the neighbourhood, and prove of benefit to farmers generally.

General Advertising.—Advertising by means other than the brand or name on the article sold has not been touched upon, but leaflet, postcard, display poster, and newspaper advertising might be considered by farmers and farmers' associations. In the case of a cheese or butter producers' association, advertisements might be placed in the trade journals of the grocery and allied trades. When individual farmers are entering a new district, or placing upon the market a fresh product, these means of advertising could be utilised to assist in the establishment of custom. It would often be cheaper to incur some preliminary expense in advertisement than wait for custom to develop slowly. By getting the working equipment into full use at the earliest possible moment more capital can be saved than is laid out in advertisement. For the purpose of advertising the products of an individual farm the "classified" pages of a local newspaper may be used, or a "display" advertisement may be inserted. Postcards of the farm or the product, or handbills may be delivered. These should state that the delivery cart will call on a certain day, preferably the day following distribution. The perfection of the arrangement should be assured; the wording should be terse and interesting and well set out. There is nothing more wasteful than printing which is not specific.

Another method of advertising which is becoming quite popular in America with urban producers and distributors is that of the display slide on the screen of the local kinema or picture theatre. This method could be used effectively by an individual farmer or a group of farmers. The farmer prospecting for custom could easily arrange for a photographic display

of his homestead—if picturesque—or a group of his cattle. A group of producers could arrange for a film giving pictures of distinctive features of the scenery of the locality, of processes of production, and of the finished product, closing with a good representation of the society's brand. Such films could be distributed over a wide range of towns. If a film were good enough to become a "feature" the mere loan of it would be sufficient to ensure its display in some picture theatres.

The British farmer can produce commodities of the very best quality and there is no reason why he should not offer them to the public in the best possible form, or take steps to ensure that the public shall realise the quality of the goods he offers.

THE CULTIVATION OF SUGAR BEET IN THE WEST OF ENGLAND.

C. S. ORWIN, M.A., and J. ORR, M.A.
Institute for Research in Agricultural Economics, Oxford.

IN continuation of the enquiry into the prospects of introducing and establishing the cultivation of sugar beet as a part of our farming system,* the writers have now conducted investigations in the counties of Gloucester, Somerset, Devon and Cornwall. These investigations revealed a situation in the last county so different from that in the others that it seems advisable to deal with it separately. On many of the best working soils from Tewkesbury in Gloucestershire to Taunton in Somerset and Bideford in North Devon, experiments in the cultivation of sugar beet were carried on during the year 1912. In this area 95 farmers grew beet on 140 acres, most of them on plots of one acre. A few of them have continued to grow very small quantities. So far as experiments conducted on this scale can be regarded as indicative of what might be achieved if larger areas were cultivated under average conditions, these served to demonstrate that heavy crops with a high percentage of sugar could be grown.

Throughout the whole of the area farmers who had tried the crop expressed themselves as fully satisfied with the yield, the majority of them saying that they grew about 15 tons of washed beet to the acre. In two or three districts—in the neighbourhoods of Stroud and of Bideford particularly—it had been grown quite successfully on some upland farms

* See this *Journal* for February, 1915, p. 969.

where the soil was deep enough, but owing to the steepness of the hills and the distance from stations, it was obvious that any development of the industry was impracticable in these districts. Elsewhere, so far as physical conditions are concerned, there is little doubt that satisfactory crops could be grown, and that the carriage of the roots to a factory would present no insuperable difficulty. Root-growing, although not widely extended, seems to be as highly developed here as in any part of the country. Speaking in a general way, and not basing their statements on actual weighings, farmers repeatedly said they got from 50 to 80 tons of mangolds per acre. Seldom or never does drought cause any difficulty in getting a crop, and therefore root crops with them are more certain and regular than they are in counties further east.

Other and more influential considerations, however, are at work, rendering the prospect of introducing the industry in these counties remote. The attitude of the farmers differs widely from that of those who were visited in Norfolk and Suffolk. Out of 20 men between Tewkesbury and Bideford who had cultivated beet successfully only three showed any positive inclination to co-operate in supplying a factory with the roots. Established customs and economic considerations more than cancel the favourable physical conditions. The arable land in Gloucester, Somerset and Devon is a small proportion of the total area, and the pressure on the narrow stretch under roots has perhaps seldom been greater. Farmers have increased the area under corn to the widest possible limits, curtailing, temporarily at least, the usual extent of the root crop. Feeding-stuffs are abnormally dear. Mangolds were said to be selling at from 15s. to 20s. per ton in Bristol, thus yielding large profits to farmers who had any to spare after providing for their own live stock. These facts are sufficient to account for their present attitude of indifference. It is true that several of the farmers were sympathetic with the idea of getting a connection with the sugar market, and of adding another branch to their industry. They had appreciated for themselves the possibility that some day the production of corn, beef and mutton may be less profitable, and that it would be well to have an additional substitute on which to rely, but even those men who, by their interest in the matter, gave the impression that they were more circumspect than the majority, offered no encouragement for the promotion of any scheme for using the present opportunity to establish a sugar beet industry.

The chief points which explain the situation in these counties may be summarised as follows :—(1) The growing of sugar beet never assumed an economic shape. The roots were not sold to make sugar, as they are in the Eastern Counties, but were fed to live stock, and farmers were recompensed by grants from outside. (2) Farmers were impressed in connection with their experiments by the difficulty and cost of lifting, the shortage of labour having been experienced for a considerable time, while the lifting machine had generally come too late or had worked unsuccessfully. (3) Corn, beef and mutton offer high and certain profits at the moment, and all call for less labour than sugar beet. A farmer near Bridgwater who had sold lambs at 53s. 6*d.* during the last week of March said he thought sugar beet might be a good thing in a depression, but just now he would not dream of reducing the area under swedes, mangolds and green food for his sheep. (4) The introduction of sugar beet, therefore, would seem to involve the breaking up of grass land, and this farmers will not contemplate with the present scarcity of labour. The conclusion, therefore, with regard to Gloucester, Somerset and Devon, is that the attitude of the farmers at the moment does not offer the slightest encouragement for providing a factory to put them into touch with the sugar market.

Enquiries which have been made by letter in Berkshire, Wiltshire, and North and South Wales seem to indicate a similar state of affairs in these districts. Sugar beet can be grown successfully, but there is no disposition on the part of the farmers to take up the enterprise at the present time.

The situation in Cornwall differs from that in the other western counties as well as from that in Norfolk and Suffolk. At first it seems natural to expect that the conditions which obtain in Somerset and Devon would be found in Cornwall, that with the prevailing high prices for most forms of produce farmers would be firmly attached to their present system. This is the case so far as north and east Cornwall are concerned, but in the south and west certain changes occur which give rise to an entirely different position. In these districts the style of farming does not permit the production on any considerable scale of the things which are now most profitable. As is the case in Cheshire and a few other counties, small holdings form a very large proportion of the total number of holdings in Cornwall. These holdings are nearly all arable, or mixed dairy and arable. They are largely devoted to growing market garden crops—early potatoes and broccoli

being the most common. For neither of these commodities have the markets improved as they have for corn, beef, mutton and even dairy products ; in fact, it is stated that competition from abroad is becoming keener. Sugar beet therefore offers, relatively, something more to the men on the small holdings than it does to the larger farmers. Milk production has benefited little by the rise in prices, and it has lost something on the other side owing to the increased cost of feeding-stuffs. The men, therefore, who are, in a sense, committed to this style of farming are securing practically no share in the improved returns, and consequently they are not so indifferent to the opportunity of getting access to a market which is certainly bigger than any that they now command.

Another consideration which causes the small holders who grow potatoes and broccoli year after year on the same soil to regard the introduction of sugar beet with some favour, is the fact that club-root has affected the broccoli rather seriously for some time. The growers would therefore welcome an alternative crop which would give them a cash return, and enable them to rid the land of the club-root infection. They think that sugar beet would serve this purpose.

Again, the labour difficulty, which was the first and last objection urged by most of the large farmers, is a less serious obstacle here, if it amounts to one at all. It was said that the crops now grown on small holdings required as much labour as sugar beet. In most cases the farmers and their families perform the greater part of this work, and do not depend on hired labour even at special seasons. They are also familiar with crops requiring a good deal of attention in small details, and the difficulties of lifting crops and transporting them to the nearest station, which loomed large in the eyes of some of the bigger farmers, are part of their normal working conditions.

In addition to these features by which the situation in Cornwall is distinguished from that in other western counties, and largely because of them, a further step has been taken towards the establishment of the sugar beet industry. The Cornish farmers have the habit of acting together for the advancement of movements which seem likely to benefit agriculture. This readiness to associate has shown itself in the very active county branch of the National Farmers' Union. Chiefly owing to the interest and activity of Mr. W. J. Hosken, of Hayle, members of the Union and other farmers have gone a considerable way towards guaranteeing a supply of sugar beet

for a factory, if one were erected. Simultaneously with the measures taken to assure the supply of sugar beet, a number of landowners, farmers and others interested in the matter declared their willingness to subscribe a substantial amount of money towards the erection of a factory, and Mr. Hosken stated that from these private sources one-half of the capital required for this purpose could be raised. A factory site was selected, and an option on it secured. The site seemed peculiarly suitable, having admirable facilities for transport by road, railway and water. Efforts were made a few years ago to start the industry, but the scheme did not materialise, for although farmers had signed contracts to grow sugar beet, the balance of the capital needed to establish the factory was not to be obtained.

With regard to the contracts a mistake seems to have been made in binding farmers to supply the roots for five years at a fixed price, taking no regard of possible fluctuations in the cost of production, or in the market for sugar, a price which would have been unreasonably low under present conditions. The farmers soon came to realise the disadvantageous position in which they had been placed, and representatives of the Farmers' Union said they were greatly relieved when the contracts became void owing to the non-erection of the factory. This experience has created a slight prejudice against the industry. The cost of growing has increased, and under the contract farmers would have been obliged to fulfil their agreements, receiving only such additional price as the factory management might have thought it expedient to concede. It seems difficult to avoid mistakes of this kind in arranging the relations of growers to the factory, for it has been noted that prejudice was created in the eastern counties in a similar way. Contracts for long periods at fixed prices are hardly reasonable in relation to a commodity so subject to fluctuations as beet sugar, since they nearly always result in one party being compelled to bear an undue share of the burden, and in an enterprise of this kind it should be quite sufficient if agreements were made for one year ahead. If the industry is likely to undergo varying fortunes, these ought to affect all parties in some definite proportion, and no agreement should be made which throws the whole burden on one, or cuts one wholly off from a share in the prosperity.

This enquiry was not exhaustive enough to justify any recommendations for immediate steps towards the erection of a factory. Before this could be done with sufficient confidence,

a more thorough investigation of the extent of the support likely to be given by the growers would be required on the part of those contemplating this step. The Secretary of the County Farmers' Union, speaking in his official capacity, said that if a definite price were offered to the farmers for the sugar beet at the farm-gate, or at the roadside, thus freeing them from uncertainty about the cost of transport and their net returns, they would be willing to grow an adequate supply. He mentioned what seemed to be a very moderate price. Too much additional, novel and uncertain work is imposed on farmers in the matter of growing and transport, and if the transport were organised in some way, it would remove one of the most serious difficulties in Cornwall.

From what has been stated it will be seen in what respect the position here differs from that in Norfolk and Suffolk. Seeing that 2,300 acres of sugar beet were grown in these two counties last year, and that individual farmers have cultivated from 5 to 100 acres, and have received considerable sums for the crops grown, there is a more substantial basis in fact in these counties for any capitalist who might think of investing money in the industry. In several respects, however, the Cornish situation is more promising. The great cohesion among the farmers is a guarantee that if the industry were taken up they would work definitely with the object of making it successful. There is less difficulty with labour, and owing to the climate the yield of the crop would probably be more certain.

This enquiry, therefore, seems to point to the conclusion that neither in Gloucester, Somerset nor Devon would it be wise or practicable to consider the erection of a factory at the present time. There is perhaps some reason for regret that this should be the case, and therefore more reason for considering sympathetically the proposal to do something in Cornwall. Although the great majority of farmers in the first three counties could not see their way to co-operate in developing the industry under existing conditions, several of the more thoughtful expressed the wish that all the preliminary and pioneer work could be done by some means, and that it might be so established that they could adopt it as easily as they have taken up dairying or potato-growing in the past. Like farmers in Suffolk, they suspect that the present high prices are not a sign of stability and soundness in agriculture, and that they will be followed by a depression in which farmers may be glad to try every market. They are not

short-sighted, but they feel that it is not their function to develop an industry for the general benefit of agriculture and for posterity, when it means that, to the extent to which they attempt this, they will be losing present opportunities of making money. Views and schemes covering developments over such long periods are appropriately entertained and carried through by wealthy associations, or by governments, rather than by farmers who hardly possess enough capital to run their business efficiently on familiar lines.

For reasons already given the situation is much more ripe in Cornwall. Capitalists who take the long view might with advantage co-operate with those farmers whose interests make it most worth while to introduce this industry, for there is little doubt that some day British agriculture will obtain a footing in the sugar market. In the fluctuations that are so likely to follow this unprecedented dislocation of the old sources and lines both of supply and demand, the stability of agriculture will be increased by every market to which the farmers can have access.

SOILS AND AGRICULTURE OF NORTH WALES.

G. W. ROBINSON, B.A.
University College of North Wales, Bangor.

DURING the course of the past five years the writer has been engaged on soil investigation work in Shropshire and North Wales. In these districts soils differ markedly from those in the south-east and east of England, where most of the English work on soil problems has been carried out. The differences are most pronounced in North Wales, and it is the purpose of this article to describe the main features of the soils of that district, and to indicate their peculiarities.

The soils of the south-east and east of England are mainly derived from Mesozoic and Tertiary formations. In North Wales, the soils are, with the exception of glacial deposits, almost entirely of Palaeozoic and Pre-Cambrian origin. There is also a marked difference in the climates of the two areas. The English area has hot summers and comparatively cold winters. North Wales has cool summers and, except in the mountains, mild winters. Temperature records show that over south-eastern England the mean July temperature is from

62° F. to 64° F., while the mean January temperature is from 38° F. to 39° F. In North Wales the mean July temperature is from 59° F. to 60° F., while the mean January temperature is from 39° F. to 42° F.

In the matter of rainfall the contrast is more pronounced. The mean annual rainfall in the south-east of England is generally less than 25 inches and rarely rises above 30 inches. In North Wales, the mean annual rainfall varies from 25 inches at Rhyl to 160 inches at Llyn Llydaw on the side of Snowdon.

There are, in the counties of Anglesey, Carnarvon, Denbigh and Flint, approximately :—

100,000 acres	with a	mean	annual	rainfall of	25	to	30 in.
130,000	,,	,,	,,	,,	30	,,	35 ,,
200,000	,,	,,	,,	,,	35	,,	40 ,,
300,000	,,	,,	,,	,,	40	,,	50 ,,
300,000	,,	,,	,,	,,	50	,,	100 ,,
70,000	,,	,,	,,	,,	100	,,	160 ,,

Most of the agricultural land is under rainfalls varying from 25 to 50 inches per annum. If detailed statistics were available, it would probably be found that the ratio of grass to arable land increases fairly regularly with increasing rainfall. It is not possible to get satisfactory evidence on this point from the official crop returns, since in the wetter and more elevated districts, rough grazing largely supplements permanent grass. Also, owing to the practice of leaving seed leys down for three, four, or even more years, at least half of the arable land in North Wales is usually in grass.

Coming to the actual characters of the soils of North Wales it may be mentioned at once that they almost invariably contain a high proportion of organic matter. This is the natural consequence of the climate, as may be readily understood from the following considerations :—

(1) The high rainfall and the mildness of the winters favour vegetable growth and render the land more suitable for grass than for arable farming. The distinction between grass and arable land is not so marked as in England, and the farmer knows that even if he ploughs up a piece of old turf he will have no difficulty in laying the land down to grass once more. Arable land is thus, for at least half the rotation, under grass.

(2) The decomposition of organic matter in the soil is retarded by various factors, all connected with the climate. In the first place the coolness of the summers probably tends to prevent the decomposition of organic matter. Further, aeration is not so thorough in grass as in arable land, nor can

it be so active in promoting decomposition when a large part of the air space of grass land is occupied by water as is undoubtedly the case during many months of the year.

(3) The drainage from soils in a wet climate such as North Wales must be much more copious than in a drier and warmer climate. At Rothamsted about half of the rainfall finds its way into the drainage. In North Wales the rainfall is higher, the temperature generally lower, and the atmosphere more humid than at Rothamsted. Evaporation and transpiration will consequently be hindered. The extra rainfall must escape as surface water or else as drainage, both of which are in consequence greater, relatively and absolutely, than in the south-east of England. It has been shown at Rothamsted that considerable quantities of dissolved matter are borne away in the drainage, notably carbonate of lime and nitrates. The loss of these valuable soil constituents is probably very high in the soils of North Wales. The heavy losses of carbonate of lime result in a marked tendency to "sourness" in soils. Of the soils examined up to the present the great majority contain no carbonate of lime. Even some soils derived from limestone have had all their carbonate of lime washed away.

There are thus several circumstances favouring the accumulation of organic matter, and these can all be attributed to the humid climate. Where land lies in an uncultivated condition in North Wales these tendencies have free play, and almost invariably result in the formation of a peaty layer at the surface of the soil.

Another characteristic of the soils of North Wales is the comparative uniformity of their mechanical composition. In the areas of soil surveyed in England well-defined types of soil appear. In North Wales, with the exception of peaty, sandy and alluvial soils, all the soils might be variants of one type. This is not due to the monotony of the geological structure of North Wales. The soils which so closely resemble one another in mechanical composition vary in geological age from Pre-Cambrian to Carboniferous and also include Glacial Drift soils.

In the field the uniformity is not so striking, the differences lying in the colour, amount of carbonate of lime, and water supply.

Generally speaking, the soils are medium loams containing sand and silt in fairly equal proportions. Clay is almost invariably the smallest fraction. Rarely does it exceed 10 per cent. of the soil, and this is surprising, since much of the soil of North Wales is derived from shales and mudstones.

The uniformity in mechanical composition is sufficiently striking to suggest that, in this area, climatic factors are predominant in determining the manner in which rocks shall disintegrate.

Chemically, the soils of North Wales show two peculiarities. Firstly, as shown above, they are almost always deficient in carbonate of lime ; and, secondly, they contain higher proportions of potash soluble in hydrochloric acid than might be expected from their mechanical composition, even sandy soils showing no marked poverty in potash. The relative richness in potash is probably due to the presence of potash minerals in the fractions of the soil usually classed as sand and gravel.

Experimental work on humid soils is as yet only beginning, but it seems likely that there is a fundamental difference between soil formation and plant nutrition in wet and dry climates. While the districts of England in which soils have been studied hitherto are not, strictly speaking, dry, yet the difference in climate between those districts and North Wales is sufficiently pronounced to make it doubtful whether the principles of plant nutrition and soil treatment, as understood at present, can be applied unconditionally in the latter area.

In the case of unmanured soils, a state of equilibrium is reached in which the loss of plant food by crops and by drainage balances the plant food rendered available by chemical and bacterial agencies. This equilibrium cannot be the same where the losses and gains of plant food are quite different. More plant food is likely to be lost to the soil through drainage under humid than under dry conditions. Manures are added to the soil to supplement the natural supplies of plant food. On the results of the Rothamsted experiments, certain principles of manuring have been formulated which doubtless hold good where the natural losses and gains of plant food are similar to those at that place. Where the losses and gains are totally different the Rothamsted work cannot strictly be used as a guide to soil treatment, and the need for new experiments under the particular climatic conditions in question is indicated.

Waste Lands.—There are in North Wales considerable areas of waste land. Much of it in Denbighshire and Carnarvonshire is moorland or mountain land lying at altitudes which render reclamation work out of the question. There are, however, areas at lower altitudes which might possibly prove suitable for reclamation. They fall into the following classes :—

(1) Sandy stretches, which occur along the southern coasts of Carnarvonshire and Anglesey, and also along the northern

coasts, around Conway, Rhyl and Prestatyn. Some of this land is already in use for market gardening and possibly the area might be extended. As an instance of the effect of the humid climate, a soil in Anglesey which grew passable crops of potatoes and carrots was found to contain nearly 95 per cent. of coarse sand.

There are also sandy stretches which were formerly arms of the sea. One of these, Malltraeth marsh in Anglesey, has an area of over 3,000 acres. It is provided with a sea wall and embanked river for drainage, but further work is necessary before really satisfactory cultivation can be practised. Were this additional work carried out, the area would probably prove very suitable for market gardening.

(2) Peat is found generally over the whole of North Wales. In Anglesey, there are several peat areas lying at low elevations which might be drained. In west Carnarvonshire a considerable area of thin peat occurs lying over a sandy subsoil. If this area were reclaimed the sand might be used to ameliorate the peat.

(3) Over a large part of Carnarvonshire west of Snowdonia there are great tracts of Glacial Drift soil which are at present almost entirely waste. Much of this land is covered with short tufts of gorse and heather, together with wiry grasses of little value. The soil is generally a thin loam over a stony clay subsoil. In many places there are patches of peat. The main task in reclaiming such soils is the clearing of stones and boulders. This has been done to a large extent in the Nantlle and other quarrying districts, where occasional labour is available. The small grass holdings thus formed appear to be fairly productive and carry grass of very good quality. Some of these grass holdings are as much as 1,000 feet above sea level.

(4) Over a large part of Denbighshire are vast heather moors. The soil is generally peat, lying over a subsoil clay derived from Silurian or Ordovician shales and flagstones. Here and there, doubtless, reclamation might be carried out, but the wetness and inaccessibility of these areas is a serious bar to their use for anything but rough grazing and sporting purposes.

Agriculture in North Wales.—The agriculture of this area and its connection with climatic and soil factors may now be outlined. Grass is the predominant feature in the farming of North Wales. This, of course, means live stock farming, and the living of the North Wales farmer is, in fact, made chiefly by the rearing of store sheep and cattle. On some farms grass

fattening is practised, but in general the soil is not sufficiently fertile or the aspect is too bleak for this type of stock farming.

The proportion of arable land is not large, and is generally less than 30 per cent. of the total under crops and grass. The usual rotation is as follows : Oats are followed by roots and a second crop of oats follows the roots. Sometimes barley is taken instead of the second oat crop. Grass seeds are sown in the second oat crop or in the barley, and the land is kept for hay for one or two years. After that it will be grazed for two, three or more years and then ploughed up again for oats. Thus it happens that half or more of the land returned as arable is always under grass.

The crops which flourish best in North Wales are oats and swedes. With good farming, eight quarters or more of oats per acre and twenty to thirty tons per acre of swedes are frequently grown.

Barley is grown to a certain extent in west Carnarvonshire and in parts of Denbighshire and Flintshire, but is more commonly used for feeding than for malting purposes.

Wheat is found in the vale of Clwyd and in east Flintshire. In these areas the rainfall is between 25 and 30 inches per annum. Where the rainfall is greater than this, wheat is hardly grown at all.

Dairying is practised in east Flint and Denbigh, and to a small extent throughout North Wales. The principal business in cattle, however, is the raising of stores, and Anglesey is the chief county for this pursuit. Its principal market, Llangefni, is largely attended by buyers from all parts of the country. Anglesey cattle are found on the pastures of the Midlands and in the fattening yards of Norfolk.

All the counties of North Wales have large numbers of sheep, but in this respect the chief counties are Carnarvonshire and Denbighshire.

Market gardening is found on a small scale in various parts along the sea coast. The mild winters in these districts should allow of much more extended cultivation of vegetables. Experiments with early potatoes instituted last year by the Bangor Agricultural Department have yielded encouraging results. Climate and soil are such that Anglesey and west Carnarvonshire might be expected to compete with Cornwall in the early potato market.

Bulb growing has been initiated in many parts of North Wales, with promising results, the yield being generally good and the bulbs of high quality. Soils from various bulb farms

have been examined by the writer. In the vale of Clwyd a bulb farm which won thirty prizes last year has been established on a rather heavy loam containing a good proportion of carbonate of lime, and lying over a stiff clay subsoil. Three soils from successful bulb gardens in Anglesey agree in being rather light in texture and containing little or no carbonate of lime. The annual rainfall in the vale of Clwyd is about 27 inches. In the districts of Anglesey where the above-mentioned bulb gardens are found, the annual rainfall is about 36 inches. It appears therefore that bulbs are not very particular as to the soil which they require.

THE PREVENTION OF EGG-LAYING ON TURNIPS BY THE DIAMOND-BACK MOTH.

R. A. HARPER GRAY, M.A., M.Sc.

Adviser in Agricultural Zoology, Armstrong College, Newcastle-upon-Tyne.

IT is well known to farmers in Great Britain that the caterpillars of the Diamond-back Moth have, in certain years, caused enormous damage to the turnip crop. Curtis quotes the letter of a correspondent who, in describing the ravages of the little green caterpillars on a field of turnips, states that "*so incredible were their numbers, that on a single plant of* moderate size, and taken at random, I counted upwards of 240, and before the end of the first week in August every leaf, for the space of more than an acre, was completely reduced to a parched-up skeleton: not a turnip escaped them, and by the middle of the month you might have looked in vain for the smallest vestige of a green leaf on the field of their depredations."*

In 1891 an outbreak of such seriousness occurred that the Board of Agriculture issued a "*Special Report on the Attack of the Diamond-back Moth Caterpillar.*" In that year the Eastern Counties, from Kent to Aberdeenshire, are recorded as having been principally affected, and the intensity of the damage done can be judged from the fact that "whole fields of turnips, swedes, rape, and cabbage were completely ruined by the hordes of caterpillars infesting their leaves."†

* *Farm Insects*, John Curtis, p. 87.

† Leaflet No. 24 (*The Diamond-back Moth*).

Miss Ormerod, in her Report on the Diamond-back Moth outbreak of 1891, brought forward some "considerations pointing to the probability of the infestations having been blown across the ocean from the Continent." (*Jour. Roy. Agric. Soc., England*, 1891, p. 612).

It would seem, however, that the occurrence of the moth in exceptionally large numbers only in occasional years can be more easily accounted for by a study of the weather and food conditions. The moth, indeed, must be regarded as being always with us. It may happen for several successive years that, owing to heavy rains, wind, parasites, etc., killing off a large percentage of the last brood of caterpillars for the year, only a small number of cocoons will remain throughout the winter to produce the spring brood of moths for the following year. If, however, conditions are such that this brood develops well and lays its eggs, and if drought and sunshine prevail until July or August, the successive broods may multiply in extremely rapid geometrical progression. Further, if the last brood of caterpillars were able, owing to good weather conditions, absence of parasites, etc., to survive the winter in the form of pupæ, the result would be a remarkable appearance of the moth in the ensuing spring.

As it is, in most seasons, rain and other conditions unfavourable to the moth seem to check its increase, while at the same time, the advent of rain helps on the crop.

The specially dry season of 1891 allowed the moth to increase enormously in the north-east of England, and the east of Scotland, until, towards the end of July and during the first part of August, low temperature was accompanied by heavy and continuous rain, which was either fatal to the caterpillars, or "washed them from the plants and checked their progress." (Leaflet No. 22).

Since that year there have been, particularly in the Northern and Eastern Counties, outbreaks of a more or less serious nature, and only last summer (1914) a large number of farmers suffered much loss owing to the ravages of the caterpillars on their turnips. A peculiarity of the attack was that, though the moths and caterpillars were particularly prevalent in some turnip fields, other turnip fields in the same district were comparatively free from the pest.

Indeed, it would appear, from an examination of the reports sent in, that the appearance of the pest was of a specially "sporadic" nature, for it is stated in one case that "in one field of turnips there were none, while a field adjoining was bad," and in another case "one field was bared in one day, the damage

stopping at the top of a hill in the field." The significance of these examples of very local infestation seems to be that the moth does not travel far, and that, therefore, efforts to rid a field of the moths or caterpillars, *at the beginning,* would have the effect of saving the crop.

About the beginning of the summer of 1914 reports of a small moth appearing in large numbers amongst turnips began to be sent in to the Agricultural Department of Armstrong College. The specimens received were, in most cases, identified as those of the Diamond-back Moth (*Plutella maculipennis,* Curtis), and it is interesting to note that the moths of this generation were of a very light colour, only a small percentage of them showing clearly the characteristic diamond-shaped markings on the wings when at rest. On June 17th specimens of the moth were brought in by a farmer in Belford (Northumberland) who stated that they were appearing not only "in clouds" amongst his turnips but also in large numbers amongst his potatoes, to which crop the early brood, issuing from cocoons in the headlands, etc., may have gone to lay eggs on cruciferous weeds therein.

No actual damage to crops was as yet observed, but, seeing that much injury was likely to be caused by the larvæ issuing from the eggs of these moths, the Agricultural Department of Armstrong College decided that this would be a fitting time to begin trials at Cockle Park with a view to preventing the female moths from laying eggs on the turnip plants.

A field of turnips was chosen where the moths were to be seen flying about in large numbers, especially in the early mornings. Square plots, each one-twentieth of an acre in area, were marked out, and received dressings as follows :—

Plot I.—Paraffin and Fine Sand : Mixed in the proportion of 1½ pints of paraffin to 1 bushel of sand and spread by hand along the drills, over and round the turnips, at the rate of 6 cwt. per acre.

Plot II.—Lime-sulphur : One pound of shell lime (slaked before boiling) and 1 lb. of sulphur were boiled in 1 gallon of water for half an hour. This was then made up to 10 gallons with water and applied at the rate of 40 gallons per acre by means of a knapsack sprayer.

Plot III.—Paraffin and Sand : Made up as for Plot I., but put on at the rate of 3 cwt. per acre, and broadcasted.

Plot IV.—Ground Lime : This was used fresh, 1 stone being applied on the plot (*i.e.,* at the rate of 2½ cwt. per acre).

All the above substances were applied on the afternoon of June 23rd, and on the following day the leaves of the turnips along the rows in each plot were carefully disturbed, when the following results were observed for each plot :—

In Plot I. (Paraffin and sand).—Practically no moths appeared.

In Plot II. (Lime-sulphur).—Several moths appeared.

In Plot III. (Paraffin and sand).—Very few moths appeared. Scarcely so good as for Plot I., but there were not so many moths disturbed as in Plot II.

In Plot IV. (Ground lime).—Practically no moths appeared.

In the other parts of the field, adjacent to the trial plots, large numbers of moths could be disturbed. The plots continued to be examined for several days afterwards, when it was observed that the moths were again beginning to be abundant in Plots I. and III., whereas they were still practically absent from Plot IV.

From the above it is evident that paraffin and sand, and ground lime have given good results in preventing egg-laying. The application of paraffin and sand, however, would have to be repeated to render this mixture effective, whereas the single application of ground lime had a lasting effect. Lime-sulphur has not given such good results as the other preparations.

It should be pointed out that an examination of the turnip leaves showed that no harmful results followed the dressing of ground lime.

With regard to the treatment of the turnips when the caterpillars are on the leaves, most benefit seems to have been derived from brushing the leaves by means of a "scuffler" to which branches were attached, or by some modification of this method. For example, Mr. Nichol, Adderstone Grange, Belford, adopted, with much success, the plan of fixing a pole in front of the scuffler with two bags hanging from the pole on each side (preferably containing a little sand or soil mixed with paraffin) in such a way that the bags brushed four drills of turnips. By this method the leaves of each drill were brushed four times during the operation of scuffling.

It was noticed by Mr. Morgan at Cockle Park, in 1914, that turnips, singled when the plants were small, suffered more from the caterpillar than when singling was done after good strong plants had developed. He also noticed that the last singled turnips suffered most, probably because the attack was more severe as the season advanced. Singling followed by heavy rains destroyed large numbers of caterpillars.

In one case starlings and plovers cleared the caterpillars from a badly attacked field of turnips in four days, after which the turnips grew vigorously, while in another case a turnip

field black with these birds eating the caterpillars showed no signs of the moth afterwards. Several reports state that rain stopped the caterpillars.

Near West Hartlepool coke fires were placed round headlands of infested turnip fields, and a large number of moths attracted by the light were killed (compare Miss Ormerod's account of the moths being attracted to lighthouses).

Practical Conclusions.—From the foregoing observations and results the following procedure is strongly recommended in dealing with this pest :—

A careful lookout should be kept, from the time when the turnips are ready for singling, for the appearance of the moth. It is small, being only about half an inch in length, and it can be readily recognised by the fact that on the posterior margin of the front wings there are whitish wave-like markings, so that, when the moth is at rest, and these two front wings meet, the markings form two or three diamond-shaped patches along the back. The hind wings, which bear fringes, are long and narrow, and of ashy grey colour. The antennæ are white, long and slender, and directed forward almost in two parallel lines.

Whenever the moth appears, 2½ cwt. per acre of ground lime should be carefully broadcasted on the young turnips, preferably on a dewy morning when there is no wind. This lime dressing might also be applied if caterpillars of the moth develop, but at this stage brushing off the caterpillars, by a pole attached to the scuffler as already described, should at once be carried out. This latter operation should be repeated if necessary. By following this procedure it is believed that large areas of turnips were saved last season.

The large number of letters of application for advice received, especially from Northumberland and Durham, showed how widely the moth had become prevalent, and the Department was satisfied that the remedies suggested had considerable effect. Further, an excellent opportunity was afforded last year of giving advice as to the outbreak, and of getting particulars of its prevalence, owing to the fact that a very large number of farmers specially attended the stand conducted by the Agricultural Department of Armstrong College at two shows (one at Newcastle-upon-Tyne, and the other at Durham) with a view to consulting about the attack of the Diamond-back Moth.

The writer desires to thank Professor Gilchrist for advice and criticism in preparing the above notes and for the great practical interest he has shown in the trials which were carried out on turnips at Cockle Park with a view to preventing egg-laying by the moth.

EXPERIMENTS ON AMERICAN GOOSEBERRY MILDEW IN CAMBRIDGESHIRE.

F. T. BROOKS, M.A., F. R. PETHERBRIDGE, M.A., and G. T. SPINKS, B.A.
Cambridge University.

One of the complaints fruit growers make against tipping as a means of checking American gooseberry mildew is that the practice, if continued, sometimes tends to spoil the shape of the bushes. The purpose of these experiments, conducted during 1913–14, was, therefore, to ascertain whether some form of spraying or soil treatment carried out on a commer-mercial basis could replace the present system of tipping. The garden chosen for the experiments was kindly placed at the disposal of the writers by Messrs. Chivers & Sons, of Histon, Cambridgeshire, with the permission of the Board of Agriculture and Fisheries; it was situated near Cambridge and contained full-grown gooseberry bushes (Whinhams Industry and Keepsake) interplanted with top fruit. It is regrettable that two varieties were present in the experimental area, but a sufficiently large homogeneous plantation could not be obtained at a convenient place. Since the introduction of American gooseberry mildew into Cambridgeshire the garden has always been one of the most heavily infected in the county, especially as regards the fruit. In October, 1913, 21 plots, each about ½-acre in extent, and one plot, No. 22, the area of which was more than 1 acre, were chosen for the experiments. Plots 1–3 and 12–22 were planted with Whinhams Industry, plots 5–10 with Keepsakes, and plots 4 and 11 half with Whinhams Industry (4A) and half with Keepsakes (4B). The bushes remained untipped after the summer of 1913. At the end of October, 1913, the amount of disease on each plot was estimated separately according to the Board's scale as "very few, very slight"* but for the whole garden the estimate was "common, very slight"*; in order to increase the opportunity for infection the following spring, additional twigs bearing perithecia were scattered on each of the plots during November. All the plots except No. 14 were dug over during the winter. The plots were treated as follows:—

Plot 1. *Sprayed with Lime Sulphur* (*spec. grav.* 1·005).—On March 31st, April 27th, and July 16th.

* We are indebted to Mr. F. G. Tutcher, Sub-Inspector of the Board of Agriculture, for these estimates, and for being the first to find the summer stage in the plots.

Plot 2. *Lime Sulphur in Powder Form applied to Bushes in Early Morning.*—On April 3rd (almost all washed off by rain on April 7th), April 29th, and July 16th.

Plot 3. *Sprayed with Bordeaux Mixture.*—On April 1st, April 28th, and July 17th.

Plot 4. *Bordeaux Mixture applied in Powder Form in Early Morning.*—On April 2nd (partly washed off by rain on April 7th; scorching of leaves subsequently apparent), April 29th, and July 17th.

Plot 5. *Sprayed on February 20th with Lime Sulphur + Lime.*—This plot was divided transversely into A and B. A received a heavy dressing of farmyard manure during the winter, B was not manured.

The spray was prepared as follows:—To 1 cwt. of lime, mixed thoroughly with 100 gal. of water, 2½ gal. of a stock solution of lime sulphur of spec. grav. 1·047 were added, the spec. grav. of the resulting lime sulphur + lime being 1·053. This spray was used because it was strongly recommended as a winter wash by a commercial firm.

The buds had opened when the bushes were sprayed. Rain fell the night after spraying.

Plot 6. *As in plot 5, but Lime Sulphur only used.*—This plot was also divided transversely into A and B and treated as in plot 5 as regards manuring.

The lime sulphur solution was made by adding 20 gal. of water to 1 gal. of the lime sulphur solution used in plot 5, which gave a solution of spec. grav. 1·0025. This strength is of course much too low for a winter spray, but was used as a partial control for the spray used in Plot 5. Heavy rain fell after spraying.

Plot 7. *Sprayed on February 9th with 1 per cent. Commercial Formalin.*—Buds were swelling when the spray was applied. Rain fell two days after spraying.

Plot 8. *Sprayed on February 9th with a Solution of Sulphate of Copper.*—Plot divided transversely into A and B. A was sprayed with 1 per cent. solution, B with a 2 per cent. solution. Other remarks as in Plot 7.

Plot 9. *Sprayed on December 8th, 1913, with a Solution of Sulphate of Copper.*—Plot divided transversely into A and B. A sprayed with a 2 per cent. solution, B with a 4 per cent. solution.

Plot 10. *Sprayed with a 2½ per cent. Solution of Caustic Soda.*—Plot divided transversely into A and B. A was sprayed on December 8th, 1913, and B on February 9th, 1914.

Plot 11. *Soil treated with Kainit at rate of 4 cwt. per acre.*—Half of the kainit was applied in November, 1913, and forked in, and the remainder in March. Considerable scorching of the leaves was noticed in April.

Plot 12. *Soil treated with Sulphate of Iron at the rate of 2 cwt. per acre.*—Half of the sulphate of iron was applied in November, 1913, and the remainder added in March, 1914. Many dead leaves were evident in April.

Plot 13. *Soil dug over during Winter as in all other Plots except* 14.

Plot 14. *Soil not dug during Winter.*

Plot 15. *Bushes heavily dressed with Farmyard Manure during Winter.*

Plot 16. *As in Plot 15, but Bushes sprayed as in Plot 1.*

Plot 17. *Soil treated with Basic Slag at rate of 10 cwt. per acre.*—Half applied in November, 1913, and the other half in February, 1914.

Plot 18. *As in Plot 17, but half* (A) *sprayed with Lime Sulphur as in Plot 1, half* (B) *sprayed with Bordeaux Mixture as in Plot 3.*

Plot 19. *Sprayed three times with a 0·2 per cent. or 0·1 per cent. Solution of Sulphuric Acid.*—The first spraying on April 28th with a 0·2 per cent. solution caused scorching of the foliage, so a 0·1 per cent. solution was used on May 16th and June 8th. Heavy rain fell soon after the last spraying.

Plot 20. *Sprayed with Lime Sulphur on same Dates as in Plot 1.*—Plot divided transversely into A and B. A sprayed with lime sulphur of spec. grav. 1·01, B sprayed with lime sulphur of spec. grav. 1·0025.

Plot 21. *Sprayed heavily during middle of February with a Solution of Sulphate of Iron so that whole area of Soil was well soaked.*—Plot divided transversely into A and B. A sprayed with a 5 per cent. solution, B with a 10 per cent. solution. Buds were forward. Rain fell 30 hours after spraying.

Plot 22. *Control.*

Results.—The summer stage of the disease was first found on April 6th on a few bushes in each of plots 17, 19, and 22. On April 23rd traces of the disease were found on a few bushes in plots 1, 3, 12, 13, 14, 15, 16, 17, 18, 19, 21 and 22. On May 2nd disease, chiefly on the berries and varying in amount, was present on all plots except 4, 7, 8, 9 and 10. All of these plots, except one half of plot 4, consisted of Keepsakes, the fruit of which is less susceptible to attack in Cambridgeshire than that of Whinhams Industry. A week later disease was present in all plots, but there was considerably less disease on the plots containing Keepsakes (" few to many, very slight ") than on most of the plots consisting of Whinhams Industry (" very many, general to bad "); this was attributed to the greater resistance of the former variety. On the other hand, Whinhams Industry which had been sprayed or dusted twice with lime sulphur or Bordeaux mixture were marked " very many, slight " at the same time. A difference between the sprayed and unsprayed Whinhams Industry remained apparent until about May 16th. Between May 9th and May 16th, the Whinhams Industry which had been heavily dressed with farmyard manure the previous winter, and had consequently made greater growth, began to be more affected than those unmanured. By May 22nd all plots of Whinhams Industry were affected to practically the same extent, each plot being marked " very many, bad to very bad " with the exception

of plots 4A and 20A, treated respectively with powdered Bordeaux mixture and lime sulphur of spec. grav. 1·01 which were marked " very many, general." From this date onwards the disease was so generally distributed that the previous treatment exercised no influence on the condition of the plots. The extremities of many young shoots were killed by the mildew.

All treatment was carried out under strict supervision, and doubtless the spraying, for which knapsacks were used, was more carefully done than could often be the case in commercial plantations.

Last year the summer stage of American gooseberry mildew was particularly prevalent on the fruit throughout the country, so that the experiments were carried out under severe conditions.

Conclusions.—1.—Spraying twice in the early part of the spring with lime sulphur or Bordeaux mixture checks the development of the disease to a slight extent, but, in the opinion of the writers, the cost of application is not repaid by the small measure of protection afforded.

2.—All forms of soil treatment and winter spraying that were tried appeared to be valueless in checking the disease during the following season.

3.—Heavy applications of farmyard manure favour the disease by encouraging an abundant succulent growth. This fact has been recognised for some time but it is desirable to reiterate it.

4.—As a corollary of (1) and (2) it follows that tipping is the only practical means known at present of reducing the amount of disease. As is well known, on account of the rapid fall of the perithecia from the shoots, this is best carried out early in the autumn. Bushes should be tipped as soon as danger of renewed growth is past, the early part of September being usually the best time for the purpose. In order to preserve the shape of the bushes as far as possible, shoots free from disease should not be tipped and the centre of the bushes should be thinned out during the winter. In view of the formation of perithecia on the berries as early as May it is important to destroy all diseased fruit as soon as possible.

SOME IRISH LARCH PLANTATIONS.

J. H. WADDINGHAM.

THE following is a continuation of an article dealing with larch woods on the Shanbally Estate, Co. Tipperary, which was published in this *Journal* for May, 1914, p. 116.

1. *General Description of Sylvicultural Conditions.*—The woods described lie on the Galtee Castle Estate, the property of Mr. J. Buckley. They are situated on the western side of the Attychraan River, which runs from north to south in the Galtee Mountains and forms a landlocked glen containing some 500 acres of larch woods.

The climatic and general soil conditions are similar to those described for the Shanbally Estate, but on the outer hills the soil is frequently very shallow, stony and poor, whereas in the glen it has a depth of 10 feet even at high elevations.

The ideal conditions for the growth of larch are a rich, deep, moist, well-drained soil, preferably on a steep bank into which the roots can easily penetrate, a moist atmosphere and shelter from all winds when the elevation reaches about 700 feet.

In such a situation in the Galtees, at an elevation of 700 feet, is a wood 45 years of age, with a height of about 73 feet, volume of 5,000 cubic feet per acre, and, allowing 1,000 cubic feet for a thinning made in 1907, a mean annual increment of about 130 cubic feet per acre per annum.

2. *Method of Measurement.*—Plots of pure larch were selected in two series of woods, one being about 25–30 years of age and the other about 55 years of age. The extremely dense woods on the estate were not selected on account of difficulties of measurement.

The volume of the main crop has been arrived at by the methods detailed in the former article.

The writer desires to express his obligation to Mr. W. R. Hickley, Agent, Galtee Castle, for permission to measure these sample plots and publish the results.

Plot.	Age, years.	No. of trees, per acre.	Mean diam., in.	*Vol. per* acre, cub. ft.	Sample trees.				Conditions of Growth.
					Height, ft.	Diam., in.	Form factor.	Volume, cub. ft.	
No. 1 Kennel Plantation	38	522	7·0	3,461	49	6·6	0·500	6·13	Soil: Well-drained, sandy loam. Aspect: *Gentle southern slope.* Elevation: 800 feet.
No. 2	58	270	11·3	6,360	73	12·25	0·467	27·93	Soil: Covered with grass, ferns and wood anemone. Aspect: Gentle eastern slope. Elevation: 730 feet.
No. 3	31	795	5·6	2,528	41	5·15	0·446	2·65	Soil: Deep loam. Aspect: East. Elevation: 900 feet.
No. 4	31	670	5·7	2,228	41	5·4	0·454	2·96	Soil: Deep loam covered with grass, moss and ferns. Aspect: Gentle eastern slope. Elevation: 900 feet.
No. 5	27	820	5·3	2,180	36·5	5·4	0·477	2·77	*Soil*: Deep loam. Aspect: Hill top exposed to all quarters except north. Elevation: 1,000 feet.
No. 6	27	880	5·1	2,100	34·5	5·1	0·486	2·38	Soil: Deep loam covered with moss and grass. Aspect: East. Elevation: 990 feet.
No. 7	28	820	5·5	2,632	40	5·1	0·478	2·71	Soil: Deep loam covered with grass. Aspect: Medium eastern slope. Elevation · 940 feet.
No. 8	28	710	5·2	1,876	37·5	5·0	0·477	2·44	Soil: Deep loam covered with grass and moss. Aspect: Steep eastern slope. Elevation: 1,100 feet.

DETAILS OF MEASUREMENTS OF SAMPLE PLOTS.
DIAMETERS CALLIPERED at 4 ft. 3 in.

Sample Plot No. 1. Kennel Plantation. Area=0·4 acre.

Diameter Class.	Dominant Crop.		Minor Crop.	
	No.	Basal Area.	No.	Basal Area.
in.		sq. ft.		sq. ft.
5	22	3·0008	Nil.	Nil.
6	57	11·1891		
7	70	18·7110		
8	43	15·0113		
9	18	7·9524		
10	—	—		
11	1	0·6600		
Total ..	211	56·5246		

Sample Plot No. 2. Area=0·3 acre.

Diameter Class.	Dominant Crop.		Minor Crop.	
	No.	Basal Area.	No.	Basal Area.
in.		sq. ft.		sq. ft.
7	2	0·5346	Nil.	Nil.
8	4	1·3964		
9	13	5·7434		
10	17	9·2718		
11	9	5·9400		
12	14	10·9956		
13	13	11·9834		
14	5	5·3450		
15	4	4·9088		
Total ..	81	56·1190		

Sample Plot No. 3. Area = 0·2 acre.

Diameter Class.	Dominant Crop.		Minor Crop.		Spruce and Scots Pine.	
	No.	Basal Area.	No.	Basal Area.	No.	Basal Area.
in.		sq. ft.		sq. ft.		sq. ft.
4	7	0·6111	14	1·2222	—	—
5	77	10·5028	14	1·9096	2	0·2728
6	53	10·4039	3	0·5889	4	0·7852
7	20	5·3460	2	0·5346	1	0·2673
8	1	0·3491	—	—	1	0·3491
9	1	0·4418	—	—	—	—
Total ..	159	27·6547	33	4·2553	8	1·6744

Sample Plot No. 4. Area = 0·1 acre.

Diameter Class.	Dominant Crop.		Minor Crop.	
	No.	Basal Area.	No.	Basal Area.
in.		sq. ft.		sq. ft.
4	1	0·0873	4	0·3492
5	30	4·0920	5	0·6820
6	27	5·3001	—	—
7	8	2·1384	1	0·2673
8	1	0·3491	—	—
Total ..	67	11·9669	10	1·2985

Sample Plot No. 5. Area = 0·1 acre.

Diameter Class.	Dominant Crop.		Minor Crop.	
	No.	Basal Area.	No.	Basal Area.
in.		sq. ft.		sq. ft.
3	—	—	1	0·0491
4	18	1·5714	11	0·9603
5	34	4·6376	6	0·8184
6	24	4·7112	—	—
7	6	1·6038	—	—
Total ..	*82*	*12·5240*	*18*	*1·8278*

Sample Plot No. 6. Area = 0·1 acre.

Diameter Class.	Dominant Crop.		Minor Crop.	
	No.	Basal Area.	No.	Basal Area.
in.		sq. ft.		sq. ft.
3	—	—	3	0·1473
4	21	1·8333	5	0·4365
5	46	6·2744	6	0·8184
6	19	3·7297	—	—
7	—	—	—	—
8	2	0·6982	—	—
Total ..	88	12·5356	14	1·4022

Sample Plot No. 7. Area = 0·1 acre.

Diameter Class.	Dominant Crop.		Minor Crop.	
	No.	Basal Area.	No.	Basal Area.
in.		sq. ft.		sq. ft.
4	7	0·6111	8	0·6984
5	39	5·3196	2	0·2728
6	26	5·1038	—	—
7	9	2·4056	—	—
8	1	0·3491	—	—
Total ..	82	13·7892	10	0·9712

Sample Plot No. 8. Area = 0·1 acre.

Diameter Class.	Dominant Crop.		Minor Crop.	
	No.	Basal Area.	No.	Basal Area.
in.		sq. ft.		sq. ft.
3	—	—	20	0·9820
4	20	1·7460	4	0·3492
5	28	3·8192	3	0·4092
6	17	3·3371	—	—
7	6	1·6038	—	—
Total ..	71	10·5061	27	1·7404

Sewage Sludge as Manure.*

THE conclusion of the enquiry of the Royal Commission on Sewage Disposal with the presentation of their Final Report affords an opportunity for reviewing the position as regards the use of sewage sludge as manure.

Small amounts of human excreta are of course applied to the land as such, with or without some preliminary treatment, but the fact that a water-borne system of sanitation is almost everywhere prevalent necessitates the use in some way of sewage as manure if the valuable manurial ingredients of human excreta are not to be allowed to go to waste. Sewage has found application on sewage farms for crops such as cabbages, turnips, mangolds and grass. Its employment in this way, however, has been limited, since large volumes of liquid have to be dealt with, of which even the best-adapted soils can absorb only relatively small quantities, so

* Royal Commission on Sewage Disposal—Fifth Report (Cd. 4278. Price 2s. 9d.), and Appendix VIII to Fifth Report (Cd. 4286. Price 3d.). Also Appendix to Ninth Report (Cd. 7820. Price 1s. 4d.).

that considerable areas of land are necessary; and sewage farming in general does not seem to have been a great commercial success.

A further method of utilising the manurial ingredients of sewage, to which much attention has been given, is the application of sewage "sludge" to the land. At the sewage works where the sewage is treated for purification the coarser solids are first removed; after this the finely divided matter in suspension is removed either by sedimentation, or precipitation with chemicals, or septic treatment. The "sludge" is the sediment so obtained, and in view of its content of nitrogen, phosphate and a small amount of potash, attempts have been made to utilise this product as manure.

It has been found that the most convenient way of disposing of this sludge is to press it into a "cake" after mixing it with lime. In some cases a charge of about 6*d.* per ton is made for it, but in others the sludge is given away to neighbouring farmers or a small fee may even be paid for its removal.

Speaking generally, properly pressed sludge when in the form of a solid cake does not give rise to serious nuisance from smell, and if exposed to the air in dry weather it soon becomes entirely inoffensive. It has, however, a slight smell of fresh sewage, and if kept moist, *e.g.*, if it is exposed to the air during wet weather, it soon becomes putrid and gives rise to offensive odours. For this reason it should, if possible, be stored under cover until it can be distributed on the land, or covered in.

The composition of the pressed cake varies according to its origin; in addition to its manurial constituents it naturally contains a good deal of lime. The actual market value, however, is insignificant owing to the relatively high cost of carriage upon a mixture containing of necessity a large proportion of water, grit and carbonaceous matter.

Experiments with regard to the use of various sewage sludges in agriculture were first carried out for the Royal Commission on Sewage Disposal about ten years ago.

Professor Somerville's trials with turnips, mangolds and swedes at five centres did not reveal any consistent manurial effect from the sludge; and the conclusion was drawn that the nitrogen and phosphoric acid of sludge are in a much less available form than the same substances in sulphate of ammonia, superphosphate and fish meal.

In experiments carried out by Mr. Middleton on grass at eight centres the application of the sludge seems to have been useful for the hay crop in the north where the wet summer

experienced favoured slow-acting manure, but the sludge produced no results in the south of England. The conclusions were drawn that, for root crops and grass, the action of the nitrogenous and phosphatic constituents of sludge is very slow as compared with the effect produced by nitrogen and phosphates supplied in ordinary artificial manures; that sewage sludge would not appear to be well adapted for such crops as mangolds, potatoes and swedes, which have a short period of growth and require quick-acting manures, and if employed it should be applied in tons rather than in hundredweights per acre; that proper quantities of sludge would be likely to form a good dressing for the slow-growing plants of many permanent pastures and meadows; and that sludge is unlikely to give satisfaction on the very poor clay-soil pastures which are so much benefited by basic slag.

Dr. Voelcker found in pot-trials with wheat that those sludges did best which contained most moisture and most lime, but that high amounts of organic matter and of total nitrogen did not produce a correspondingly good result, while all the sludges tried were somewhat inferior to artificial manures supplying equal amounts of approximately like ingredients. An increase of 10 to 12 per cent. in corn and in straw over the unmanured produce was, on the average, obtained, as against one of 16 to 17 per cent. with artificial manuring. Based on the extra produce obtained the best of the sludges was valued at 10s. a ton delivered on the land.

The experiments for the Royal Commission on Sewage Disposal did not end with the above trials, owing to the subsequent discovery of an efficient process for "de-greasing" the sludge. It must be explained that natural sludge contains a large amount of grease and soapy matter (equal to from 10 to 15 per cent. of the dry matter). Grease is of no value as manure and, in fact, is supposed to exercise a retarding influence by preventing the ready decomposition of the organic and nitrogenous matters with which it may be mixed.

The effect of these "de-greased" sludges was compared with that of natural sludges on wheat at Woburn and on hay and oats at Rothamsted in 1913–14.

At Woburn the natural sludge was found to contain more moisture, more nitrogen and more soluble nitrogen than the de-greased, an application of 1 ton per acre supplying 45 lb. of nitrogen in the case of natural sludge and 40 lb. in the case of de-greased sludge. The following table shows the yields of grain and straw from various dressings:—

Treatment.	Weight of Produce (untreated = 100).	
	Corn.	Straw.
Untreated	100	100
Natural sludge :		
1 ton per acre	122	102
2 tons per acre	120	112
1 ton per acre + ½ ton lime ..	132	110
De-greased sludge :		
1 ton per acre	101	107
2 tons per acre	118	102
1 ton per acre + ½ ton lime ..	122	111
Lime only—½ ton per acre ..	113	102

Thus the average increase in grain over the untreated produce was 25 per cent. with the natural sludge and 14 per cent. with the de-greased. The best results were obtained with lime, but that this was not due to lime alone is shown by the yields where lime was applied without sludge.

At Rothamsted, also, the nitrogen content of the natural sludge (1·76 per cent.) was found to be above that of the de-greased sludge (1·55 per cent.), while the content of phosphoric acid was 0·85 and 1·33 per cent. respectively.

In the grass experiments the manures were applied at the uniform rate of 20 lb. of nitrogen per acre (equivalent to about half a ton of sludge) with the following results :—

Treatment.	Yield of Hay per acre. cwt.
Untreated	17·64
Natural sludge	18·64
De-greased sludge	16·29
Calcium cyanamide	21·59
Nitrate of soda	25·93

The effect of the sludges was negligible. It should be mentioned that the season was a distinctly dry one.

Experiments with oats were carried out on the same plan, but from neither of the sludges was so good a return obtained as where no treatment was given, the sludges being applied so as to supply 16·67 lb. of nitrogen per acre.

The results of the Rothamsted experiments are taken to indicate the lack of evidence to the effect that the removal of the fat from the sludge increases the ease of decomposition in the soil.

The point towards which laboratory and other experiments should in future be directed seems to be the discovery of some method of rendering the nitrogenous matter of the sewage sludge more readily available as plant food than at present.

Malt Culms.

MALT culms or coombs consist of the rootlets or shoots thrown out by barley during its conversion into malt. These rootlets and shoots, which in amount represent about 3 per cent. of the original barley, are separated by screening and afterwards dried. The best quality malt culms are about ½ in. in length, are light in colour, and are slightly curled, crisp, and thread-like in appearance. They possess a pleasant, aromatic smell when moistened with water, and should be almost free from dust. In recent years the bulk of the malt culms produced in this country has been exported. This is not the case at present, and farmers will do well to consider the possibility of using them freely in the rations fed to their stock. At present prices they should prove an economical feeding stuff.

Composition.—Malt culms in themselves vary widely in composition, and as this variation is often accentuated by the presence of a quantity of more or less malted barley kernels, the average analysis may not always afford a reliable indication of the contents of a particular sample. In general, however, it may be said that malt culms are characterised by a high albuminoid content, little fat and a deficiency of lime in the ash. The following are the averages of a number of analyses carried out in the United States, Germany and England respectively :—

——	Dry matter.	Albuminoids.	Fat.	Carbohydrates.	Woody Fibre.	Ash.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
United States ..	89	26·4	1·3	43·1	12·3	5·9
Germany ..	90	24·4	2·0	42·4	14·0	7·2
England (Smetham)	90·2	26·28	1·03	45·96	11·08	5·85

The high proportion of albuminoids present would seem to indicate that malt culms should be placed in the same category as the leguminous seeds and oil cakes. It is found, however, that a considerable portion of the total albuminoids is in the form of amides which possess a relatively low nutritive value. In five analyses of malt culms with albuminoid contents ranging from 22·35 to 34·5 per cent., Kellner found that only 17·29 to 25·64 per cent. of the albuminoids were in the form of true albuminoids. On the other hand experience has shown that malt culms are highly digestible. Experiments carried out by

Wolff, Kuhn and Armsby showed that when fed to sheep 81 per cent. of albuminoids, 68 per cent. of fat, and 76 per cent. of carbohydrates contained in the culms were digested, and that when fed to pigs the corresponding percentages were 75 of albuminoids, 65 of fat and 85 of carbohydrates.

Malt culms form an excellent supplementary food for all kinds of farm stock, especially for dairy cows and sheep. They stimulate digestion and are usually eaten with relish. It should be pointed out, however, that the feeding of large quantities, especially in the dry form, is apt to cause digestive troubles, and even abortion in the case of breeding animals. The best results are obtained by feeding moderate quantities in mixed rations.

Dairy Cows.—Malt culms may perhaps be used with the greatest advantage for feeding dairy cattle. Their effect on both the yield and quality of the milk is favourable and they produce well-flavoured butter. The culms should partially replace concentrated foods, and may be fed in conjunction with straw chaff, and succulent green food. Occasionally culms are not relished by cows at first, but, if gradually introduced into the ration, they will soon be readily eaten. Up to 3 or 4 lb. per head per day may be fed without risk. When fed at the higher rate it is usually advisable to steep them in boiling water before using.

Adult Cattle.—Malt culms may also be usefully fed up to 5½ lb. per day to cattle during the first part of the fattening period. During the later stages of fattening they are not always willingly eaten. The culms should be steeped in water. A ration composed of malt culms, brewers' grains and straw chaff has been fed with advantage.

Calves.—After calves have reached the age of 3 months, malt culms may be gradually introduced in place of milk. It is recommended that they should be thoroughly moistened with boiling water and fed when lukewarm. Not more than a pound or two should be fed before the calves reach the age of 6 months, but afterwards they may be fed at the rate of 2 to 3 lb. for every 200 lb. live weight.

Horses.—Malt culms have been successfully utilised as a partial substitute for oats in rations for horses without in any way reducing the working capacity. The best plan is to commence with a small amount, say ½ lb., and gradually increase it. Up to 6 lb. of culms may be fed in the dry form, and if supplemented with oats and chaff will provide a useful ration.

Foals, also, may receive small quantities along with crushed oats.

Sheep.—Sheep may receive malt culms at the rate of ½ lb. per 100 lb. live weight. They should be fed dry with straw chaff, and succulent green food. Lambs will also thrive well on a mixture of malt culms, crushed grain and chaff.

Pigs.—From ½ lb. up to about 2½ lb. per head of malt culms according to age and size, may be fed to fattening pigs. The culms make a good ration fed with skim milk. In America a mixture of malt culms and molasses is often used with good results. Culms are said to be unsuitable for breeding sows.

Poultry.—Small quantities of malt culms may be fed to hens.

Malt culms are best fed in a fresh condition as they are then more easily digested than when stale. When stored care should be taken to keep them in dry, airy and dust-free places. They easily absorb dust and moisture from the atmosphere, and, in consequence tend soon to develop moulds and fungoid growths. Damaged culms may lead to abortion in breeding animals and inflammation of the digestive organs in calves and pigs. Samples of dark brown culms should also be avoided; they either contain harmful products of decomposition owing to fermentation while damp or are indigestible on account of the steeping process being carried out too rapidly. Provided, however, that care is taken to obtain only malt culms of good quality, free from foreign matter, farmers will find in them a valuable feeding stuff which will form an economical and efficient substitute for many of the concentrated feeding stuffs at present in use.

Home-made Rennet Extract.

RENNET, as used for the purposes of cheese-making, is a liquid or powdered preparation containing the rennet ferment which is a secretion of the rennet glands in the lining of the stomach, and is found in most animals. The rennet ferment exerts a powerful action on the caseous matter of milk, and its function in the stomach, where it occurs in the gastric juice as *rennin*, is to cause curdling of the milk ingested; thus the ferment is especially abundant in the stomachs of young animals while still suckling, and is present in the greatest amount when a meal has just been digested. For the preparation of rennet extract the stomachs of calves, known commercially as "vells," are almost exclusively employed on account of the ease with which they can usually be procured. A calf fed on milk secretes enough gastric juice

in a day to coagulate 10 gallons of milk in one minute. As soon as its food, however, is changed to cereal products and grasses, the composition of the juice changes to meet the new requirements, and is no longer so powerful for dealing with milk.

Very little rennet is now manufactured in this country, and cheese-makers have for some time been largely dependent on the supplies from Denmark and Holland. Since the outbreak of war the supplies have been short and very difficult to obtain, and, while there appears to be little danger of a great shortage, prices have advanced considerably, so that for commercial rennet solutions 10*s.* to 12*s.* 6*d.* per gallon has been charged in place of a normal price of from 7*s.* to 8*s.* One reason for the shortage apparently lies in the fact that a large proportion of the rennet extract was prepared from Russian vells, which are not now available.

The Board have received information that one firm, who are large importers of and wholesale dealers in rennet, are making arrangements for the collection of vells and the manufacture of rennet in this country, and they anticipate that before long the supply will be increased, and that prices will fall considerably. Nevertheless, since there appears to be a possibility that farmers will experience some difficulty in obtaining supplies from the usual sources at normal prices, it may be useful to deal briefly with a few methods of preparing a home-made rennet extract.

Drying the "Vells."—For the reasons stated above, the "vells" of sucking or milk-fed calves only should be used. When the calf is killed, the fourth or digestive stomach should be removed immediately, leaving a small portion of the third stomach attached. The contents should be squeezed out, but, in order to avoid loss of the rennet ferment, the stomach should not be turned inside out or washed internally. The larger end of the stomach should then be tied, and the stomach blown up hard, after which the narrow end should be tied at the neck. It may be hung to dry in a draughty shed or in a warm, dry room, but it should not be subjected to undue heat or hung in the open, exposed to the sun. The drying should not take more than a week or there is a risk of putrefaction. The neck should then be removed, after which the vell is ready for use.* The vell may with advantage be sprinkled with salt previous to being dried.

Preparation of Rennet Extract from the Dried "Vells."—Before the extensive introduction of commercial rennet

* *Agricultural Gazette of Canada*, March, 1915.

extract, the rennet was usually prepared in the cheese factory. Before being dried, the vells stood for some hours first in pure water and then in water rendered sour with acid whey or citric acid at a temperature of 68–95° F. They were sometimes preserved by the addition to the soaking liquid of salt, spirits of wine, pepper, saltpetre, herbs, etc. Occasionally the vells were finely minced and treated with 5 per cent. of salt and pepper. The mass was then dipped in vinegar, and after 8 or 12 hours mixed into a paste by the addition of buttermilk and made into balls as large as the fist, which were left for 3 to 4 weeks in a warm, dry place, slightly smoked, and kept until required.

A method of preparing rennet recommended by Sheldon* is as follows :—A brine solution, consisting of 1 part of salt to 20 parts of water, is boiled for half an hour, and when it is cold 6 rennet skins are added to every 2 gallons of the liquid. The skins are left in the liquid for a month, during which time they are gently rubbed several times between the hands. At the end of a month the skins are removed from the liquid, which is then ready for use, and will keep good for a long period if air is excluded. Sheldon mentions another method in which salt brine capable of floating an egg is made. To every gallon of this 4 vells, ½ oz. of saltpetre, and half a lemon sliced are added. The liquid is ready for use after a month.

A recipe devised by Soxhlet† is to cut up the vells into small pieces, and for every 1 lb. of skin, 1 gallon of water, ½ lb. salt, and 6½ oz. of boracic acid are taken. The mixture is then left to stand for 5 days with frequent shaking. To every gallon of water used a further quantity of ½ lb. of salt is added, and the solution is then filtered. The cost of the extract per gallon, assuming that about 15 vells are used, was estimated by Soxhlet to be about 3*s.* 6*d.*

According to Oliver,‡ the best method of preparing rennet extract is to use boiled and filtered rain-water, in which mineral impurities are in the least possible proportion, and to add as much salt as can be dissolved, the vells being immersed, when the liquid has cooled, at the rate of 4 to every gallon. He states that brine, though a good preservative, does not extract the full strength of the skins, and 8 vells once soaked will make a second gallon of steep. Experiments have been made to test the advantage of steeping the vells in boiled and filtered water for several days, in order to secure more complete extraction, and then saturating the steep with salt. Fermentation frequently set in, and the after-salting did not render harmless the foul effects of the fermentation.

* *Dairying*, by J. Prince Sheldon. † *The Book of the Dairy*, by W. Fleischmann.
‡ *Milk, Cheese and Butter*, by John Oliver.

Another method is to cut the vells into small pieces, steep them in a 5 per cent. solution of brine, and stir and pound well at intervals for a week. The liquid should then be removed and replaced by more brine, with the repetition of the treatment for a further week.

Home-made extract of rennet may be filtered through clean straw, sand and charcoal; it should be dark in colour but should be clear, and free from turbidity, which is a sign of the beginning of decomposition. Preservatives may be added to the extract, but according to Fleischmann they increase the keeping properties of the solution at the expense of its strength, since they render a portion of the rennet ferment inactive.

Rennet powder is obtained by adding an excess of salt to the rennet solution. The rennet is thus precipitated and, after drying the precipitate, a powder is obtained consisting essentially of the ferment, together with other organic matter and a considerable amount of salt.

A practice which appears to be adopted in some farmhouses is to put a piece of rennet skin in to soak each day for the next day's use. By this plan, however, the strength is not thoroguhly extracted from the skin, and the liquid, though fresh, is not uniform in quality from day to day. The method of making a steep in whey is also not to be recommended, as it is liable to lead to undesirable forms of fermentation.

The Irish Pig-Breeding Industry.*

THE Irish pig-breeding industry brings in an average annual gross return of about £8,000,000. On an average over 1¼ million pigs are handled annually by Irish curing firms, and approximately four-fifths of the cured bacon and hams are exported, Great Britain deriving about one-fifth of its imports of bacon and hams from Irish sources. Further, in normal seasons over 300,000 head of pigs are annually shipped alive from Ireland, the bulk of them being known as "heavy weights" (of from 2½ cwt. to 3 cwt. in weight) and being shipped in the late autumn months, while the lighter weights are known as "sizeable"; there is also a considerable export of dead pigs from Ireland.

A Small Holder's Industry.—The industry in Ireland is essentially that of small holders, the reason being that larger farmers are hampered by the scarcity of labour and chiefly devote their attention to the raising of store cattle or to beef production. The family of the small holder supplies cheap

* Summarised from the Report of the Departmental Committee, appointed by the Department of Agriculture and Technical Instruction for Ireland, on the Irish Pig-Breeding Industry [Cd. 7890].

labour, in addition to which the tillage carried on on small farms enables the holder to provide quantities of home-grown foods which can be utilised to great advantage by being fed to pigs. The keeping of pigs by farm labourers, and indeed by the labouring classes generally, seems to be decreasing; this is partly due to an unwillingness to engage in the work of looking after the pigs after working hours or on Sundays, partly to lack of housing accommodation, partly to sanitary restrictions in towns, and partly to the substitution of poultry and eggs for pigs under the impression that the former are more profitable.

Breeds.—The class of animal reared in Ireland has undergone a marked improvement as a result of the selection work carried on by breeders; not only has the quality of the product increased, but the animals are finished in shorter time and on a smaller amount of food than was formerly the case.

Under a scheme of the Department of Agriculture and Technical Instruction for Ireland premiums are given in respect of boars of approved breeds of £5 in the first year (this is reckoned to be equal to the purchase price), and of an additional £3 if the animals are kept until the second year; in 1914 premiums were given in respect of 563 boars, *i.e.*, about one-quarter of all the boars in the country. The breeds subsidised are the Large Yorkshire and the Large White Ulster. The popularity of the Large Yorkshire is due to the fact that it is an extremely thrifty animal which makes a nice bacon pig at an early age and meets fully the requirements of the London and south of England markets. For the long side trade a well-ribbed pig which will give a carcass showing a high proportion of lean meat and not carrying too much fat is required; the curers in the south of Ireland have found the most suitable animal in the cross of the Large Yorkshire boar with the common type of sow found on Irish farms. Further advantages claimed for the Large Yorkshire pigs are that they are extremely hardy and that the thick skin enables the carcass to be transported for considerable distances without injury or discoloration, or to be singed without any risk of the skin cracking and the pork being injured.

The Large White Ulster is a heavier pig, with thin skin, and has the reputation of coming more quickly to a marketable weight in proportion to the food given than does the Large Yorkshire; owing to its deep side it specially meets the requirements of curers in the north of Ireland, who put their bacon on the market "rolled."

The Large Black is also kept, but is generally regarded with disfavour because the discoloration of the skin leads to smaller returns.

Fattening.—In Ulster young pigs of from 8 to 10 weeks old are put to fatten from weaning and reach 1½ cwt. in four months, so that it is possible to turn out three finished lots in the year. This is considered the best method, and its adoption is being urged in place of that obtaining in the other three Irish provinces, where the young pigs are farrowed in the early spring months, run as stores during the summer, and only put to fatten when the potato crop becomes ready for use ; under this latter system the animals are usually marketable as heavy weights during the winter months.

An elaborate series of feeding trials with pigs has been carried out by the Department of Agriculture and Technical Instruction for Ireland. These have shown :—

(1) That pigs can be fattened with less food in summer than in winter ;

(2) That barley, pollards and maize produce practically the same live weight increases, and that barley produces a better quality of pork than maize ;

(3) That approximately 5 cwt. of meal may be calculated to produce 1 cwt. of pork ;

(4) That 20 cwt. of potatoes in a mixed ration will produce 1 cwt. of pork ;

(5) That in a mixed ration 1 gall. of separated milk or buttermilk is approximately equal to 2 lb. of maize meal ;

(6) That a larger increase of weight is obtained for the amount of food consumed in the early stages of fattening than in the later stages ;* and

(7) That raw meal (*i.e.*, steeped in cold water for periods up to 12 hours) gives greater gains than cooked meal, there being no difference in the quality of pork produced.

The Irish Committee on the Pig Breeding Industry.—From 1851 to 1910 the number of pigs in Ireland remained fairly constant at about 1¼ million head, but the number has dropped seriously in recent years, viz., from 1,415,000 in 1911 to 1,060,000 in 1913. A committee appointed by the Irish Department of Agriculture and Technical Instruction to enquire into the subject found that the decline was due in particular to the low prices of pork prevailing previous to the enquiry, the high prices of feeding stuffs, and the poor yield of potatoes in 1912 ; as general causes preventing the desirable

* See also Dr. Crowther's article in this *Journal*, March, 1915, p. 1073.

continuity of the industry various difficulties connected with marketing (especially fluctuations in prices, which vary as much as 3s. per cwt. in a week) were indicated, in addition to the lack of labour and housing accommodation and the substitution of poultry for pigs.

The evidence given before the Committee showed conclusively that the farmers who obtain the best results are those who *regularly breed and feed* a certain number of pigs, and Irish pig breeders are therefore advised to discontinue their present practice of giving up pig breeding and feeding when pork prices are low and commencing again when the value of pork is high.

The Committee's recommendations include suggestions that the maximum value of the premiums given in respect of boars (see above) should be increased; that an increase in the value of the service fee should be considered; that the Department of Agriculture and Technical Instruction should annually import a limited number of high-class pure-bred boars from the most reliable herds in England, these animals to be either sold on reduced terms or leased at a small charge to breeders of premium boars; that power should be sought from Parliament to permit only such boars as are registered after inspection to stand at a service fee in Ireland; and that the Department should institute experiments as to the value of forage crops, such as vetches, rape, clover, &c., in order to ascertain if these crops can be utilised profitably for pig feeding.*

With regard to housing it is recommended that local authorities in Ireland should provide pigsties in connection with the cottages erected under their schemes; and that attention should be given to the improvement of pigsties on small holdings.

A system whereby bacon curing firms should inform feeders of the type of pig in demand and notify them from time to time regarding the weight of pigs likely to command the highest price is advocated.

It is thought that the Irish pig breeding industry will be in a very favourable position in the immediate future as a shortage in the pig supplies from Canada, the United States, Denmark, and the Continent generally, is anticipated.

---

* In connection with this subject see the Board's Special Leaflet No. 30. *The Use of Forage Crops for Pig Feeding.*

Notes on Feeding Stuffs in June: From the Animal Nutrition Institute, Cambridge University.

THE table on p. 249 gives the prices per ton and per food unit of thirty-one feeding stuffs at London, Liverpool, Hull and Bristol at the beginning of June. This table includes the same feeding stuffs as those dealt with in former notes already published in this *Journal*,* and is compiled on similar lines. For explanation of the meaning of the terms used, *e.g.*, *food units*, former notes should be consulted.

In the list below, the feeding stuffs are arranged in order of average price per food unit :—

	s.	d.	
Brewers' grains (wet)	0	11	per food unit.
Soya bean cake	1	3½	,, ,,
Maize gluten feed	1	4½	,, ,,
Coconut cake	1	5½	,, ,,
Palm-nnt kernel cake	1	5¾	,, ,,
Decorticated cotton cake ..	1	6	,, ,,
Brewers' grains (dry)	1	6½	,, ,,
Linseed cake, Indian	1	6¾	,, ,,
Malt culms	1	7¼	,, ,,
Wheat pollards	1	7¾	,, ,,
Linseed cake, English	1	8	,, ,,
Wheat bran	1	8½	,, ,,
Wheat middlings	1	8½	,, ,,
Maize germ meal	1	9¾	,, ,,
Wheat bran, broad	1	10¼	,, ,,
Rice meal, Burmese	1	10¼	,, ,,
Maize, Argentine	1	10¼	,, ,,
Wheat sharps	1	10½	,, ,,
Cotton cake, Egyptian	1	10¾	,, ,,
Maize, American	1	11¼	,, ,,
Cotton cake, Bombay	2	0	,, ,,
Beans, Chinese	2	0	,, ,,
Beans, English	2	0¼	,, ,,
Peas, English dun	2	0½	,, ,,
Maize meal	2	1¾	,, ,,
Barley, English feeding	2	4½	,, ,,
Peas, English maple	2	7	,, ,,
Oats, Argentine	2	10½	,, ,,
Peas, Calcutta white	2	11	,, ,,
Oats, English	3	1½	,, ,,

Comparison with last month's list shows that there is not on the whole much alteration in price. Brewers' grains

* March, 1915, p. 1111; April, 1915, p. 52; May, 1915, p. 148.

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate prices per ton at the beginning of June.				Approximate price per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya Bean Cake	1 : 1·1	122·3	—	8 7 6	7 15 0	7 17 6	—	1 4	1 3	1 3¼
Decorticated Cotton Cake	1 : 1·3	126·3	8 18 9	10 5 0	—	9 5 0	1 5	1 7½	—	1 5½
Indian Linseed Cake	1 : 1·9	123·1	—	9 12 6	9 15 0	—	—	1 6½	1 7	—
English Linseed Cake	1 : 2·0	120·1	10 1 3	10 10 0	9 15 0	9 17 6	1 7¾	1 9	1 7¼	1 7½
Bombay Cotton Cake	1 : 2·4	65·3	6 10 0	6 10 0	6 10 0	6 10 0	2 0	2 0	2 0	2 0
Egyptian Cotton Cake	1 : 2·0	71·9	6 12 6	7 0 0	6 17 6	6 15 0	1 10	1 11½	1 11	1 10½
Coconut Cake	1 : 3·8	102·6	6 15 0	7 10 0	—	7 10 0	1 3¾	1 6½	—	1 6½
Palm-nut Kernel Cake	1 : 4·0	83·5	6 0 0	5 0 0	—	6 10 0	1 6¾	1 2½	—	1 8
English Beans	1 : 2·6	99·5	9 9 0	10 14 0	9 9 0	10 2 0	1 10¾	2 2	1 11	2 1
Chinese Beans	1 : 2·6	101·2	10 0 0	10 14 0	10 0 0	—	1 11½	2 1¼	1 11½	—
English Maple Peas	1 : 3·2	97·2	10 17 0	14 9 0	11 15 0	—	2 3	3 0	2 5½	—
English Dun Peas	1 : 3·2	97·2	10 0 0	—	9 16 0	—	2 0¾	—	2 0	—
Calcutta White Peas	1 : 2·3	97·5	14 9 0	14 0 0	—	—	2 11¾	2 10¼	—	—
American Maize	1 : 11	93·8	9 2 0	9 2 0	—	—	1 11¼	1 11¼	—	—
Argentine Maize	1 : 11	94·2	8 12 0	9 0 0	8 15 0	9 0 0	1 9¾	1 10¾	1 10	1 10¾
Maize Meal	1 : 13	86·5	9 0 0	9 15 0	10 0 0	8 7 6	2 1	2 3	2 3¾	1 11
Maize Gluten Feed	1 : 3·3	121·6	8 0 0	—	—	8 10 0	1 3¾	—	—	1 5
Maize Germ Meal	1 : 8·4	99·2	8 17 6	9 0 0	9 7 6	9 0 0	1 9¼	1 9¾	1 10½	1 9¾
English Feeding Barley	1 : 7·8	83·0	—	10 6 0	9 10 0	9 15 0	—	2 5¼	2 3½	2 4¼
English Oats	1 : 7·9	75·4	11 16 0	11 17 0	11 10 0	12 0 0	3 1¾	3 1¾	3 0½	3 2¼
Argentine Oats (Buenos Ayres) ..	1 : 7·9	75·4	10 14 0 }	10 11 0	11 1 0	10 14 0	{ 2 10 }	2 9½	2 11¼	2 10
Argentine Oats (Bahia Blanca) ..	1 : 7·9	75·4	11 2 0 }				{ 2 11¼ }			
Malt Culms	1 : 3·6	69·9	5 5 0	6 10 0	5 0 0	5 15 0	1 6	1 10¼	1 5¼	1 7¾
Brewers' Grains (dried)	1 : 3·4	84·5	6 10 0	—	6 5 0	6 15 0	1 6½	—	1 5¾	1 7
Brewers' Grains (wet)	1 : 3·4	21·1	15 6	—	1 4 0	—	9	—	1 1¼	—
Egyptian Rice Meal	1 : 10·3	78·7	—	—	—	—	—	—	—	—
Burmese Rice Meal	1 : 10·3	78·7	8 0 0	6 12 6	—	7 5 0	2 0½	1 8¼	—	1 10
Wheat Middlings	1 : 5·3	93·4	7 17 6	—	7 5 0	9 0 0	1 8¼	—	1 6½	1 11
Wheat Sharps	1 : 5·3	86·3	7 12 6	*[8 10 0]	8 5 0	8 2 6	1 9	1 11½	1 10¾	1 10½
Wheat Pollards	1 : 5·3	81·9	—	6 15 0	—	—	—	1 7¾	—	—
Wheat Bran	1 : 5·3	77·5	7 0 0	6 7 6	6 10 0	6 10 0	1 9½	1 7½	1 8¼	1 8¼
Wheat Bran (broad)	1 : 4·7	79·9	7 10 0	7 2 6	8 0 0	7 0 0	1 10½	1 9¼	2 0	1 9

* Fine Sharps (Thirds)

have gone down, which is not surprising, as they are little used in summer when there is grass to be had for the cows. Coconut cake has gone up about a penny per unit. Our experience with it during the last month indicates that it does not keep well in warm weather, but is apt to develop a rancid smell and taste which makes it less acceptable to animals. Indian linseed cake has remained at 1*s.* 6¾*d.* per unit, and at this price should be used in preference to other feeding stuffs for the several purposes indicated below. Dried grains have fallen, and may be used with advantage for some purposes. Both Egyptian and Bombay cotton cake have risen considerably, by ¾*d.* and 1¾*d.* per unit. Fortunately this dry season they can be replaced economically by linseed cake, which is now much cheaper per food unit than cotton cakes. The price of feeding barley and oats is still practically prohibitive. This is also the case with peas. The price of wheat offals may fall during the month if the fall in the price of wheat continues.* Considerable local variations in price still occur. Palm-nut kernel cake, for instance, costs only 1*s.* 2½*d.* per unit at Liverpool, which is 4*d.* per unit less than it costs in London, and 5½*d.* cheaper than at Bristol. Malt culms are dearest by several pence per unit at Liverpool.

It has been suggested that certain proprietary articles should be included in these notes, such as some of the mixed cakes and sugar feeds. There is a difficulty in adopting this suggestion, for such articles have no definite average composition on which an estimate of their content of food units can be based. Anyone who proposes buying such feeding stuffs can, however, make a rough calculation of the food units from the guaranteed analysis of the maker or seller, using the formula given in former notes.† From the number of food units thus calculated about one-fifth should be subtracted in order to get a rough estimate of the number of digestible food units. The price per ton divided by this final figure will then give the price per unit for comparison with the standard foods given in the lists printed in these notes. The nutritive ratio should also be calculated by multiplying the percentage of fat by 2¼, adding the percentage of carbohydrates, and dividing by the

* In this *Journal* for March, p. 1118, it was suggested that at present prices a more extensive use might be made of sharps and middlings. Since then a preliminary trial of sharps has been made with fattening steers. The figures are not yet ready for publication, but they seem to indicate that sharps should not be used extensively for fattening cattle until further trials have been made.

† This *Journal*, May, 1915, p. 148.

percentage of protein. This gives an estimate of the proportion of flesh-forming protein to heat- and fat-forming constituents, and assists in deciding if the food is suitable for the purpose for which it is required. If sellers of these articles will send to the Director of the Animal Nutrition Institute, School of Agriculture, Cambridge, guaranteed analyses and prices of their standard brands of foods, it may be possible to consider them for the next notes published.

Below are given suggestions for rations in June :—

For Horses at Farm Work.—The same ration as that given last month may be used, namely :—

4 lb. Wheat sharps,
2 ,, Crushed maize, and
1 ,, Bean meal.

This should be mixed with damp chaff. The usual ration of long hay or green fodder should be used. Where horses are not given hay or green-stuff, but have to graze the dry benty grass which will result if this dry weather continues, it may be advisable to add 1 or 2 lb. of linseed cake to the ration of dry food as a laxative. It is necessary to increase by 2 or 3 lb. the whole concentrated ration for very large or free working horses.

For Cattle finishing for Beef on Roots or Green-stuff.—Last month's ration cannot be improved. If, however, the green-stuff is vetches or lucerne, both of which contain much protein, half the linseed cake may be replaced by crushed maize, or maize meal may be given in place of bean meal.

For Cattle finishing for Beef on Grass.—If the drought continues, the grass will be dry and benty, with no tendency to produce scouring. In these circumstances linseed cake should be used, as at present prices it is cheaper than cotton cake. Where the grasses are short and the pasture is closely cropped, so that the animals chiefly get small clovers which are rich in protein, broken or crushed maize would be more suitable than linseed or other cake.

For Cows at Grass.—If the grass is making plenty of growth, cake may be stopped. If the grass is short and dry owing to continued drought, linseed cake should be used in place of cotton cake, as it is now cheaper per food unit. Coconut cake is apt to go rancid in hot weather, and to become distasteful to stock.

For Calves for Baby Beef at Grass.—The same ration as last month.

For Heifer Calves and Store Steers at Grass.—The same ration as last month.

For Store Lambs at Grass, or on Rape or Cabbages.—$\frac{1}{4}$ lb. linseed cake and $\frac{1}{4}$ lb. dried brewers' grains. If the lambs are on vetches or crimson clover or clover aftermath—$\frac{1}{8}$ lb. maize.

For Lambs Fattening on Grass.—$\frac{1}{4}$ lb. linseed cake, and $\frac{1}{8}$ lb. maize.

For Pigs of all Kinds.—Rations as in last month's notes.

Notes on Fruit Cultivation at Westwick, Worstead, Norfolk.

UP to the present time very little has been done by large commercial growers in the crossing of well known types and varieties of small fruit. Occasionally a sport or stray seedling has been observed, and, by growing on, a variety of considerable merit has sometimes resulted. This class of work has been left almost exclusively to a few large firms who have gained a reputation as raisers of stocks of fruit bushes and trees.

Experiments in Crossing Black Currants.—Black currants are cultivated very successfully by Colonel Petre on his estate at Westwick, Worstead, Norfolk. Mr. George Davison, who is in charge of the plantations, is a hybridiser well known to horticulturists. His chief successes, up to the present, have been with herbaceous plants, notably Montbretias, but as a fruit grower he is almost equally well known. His long experience in handling large areas of black currants enables Mr. Davison at once to detect the defects of existing varieties and to decide on the most likely methods of improvement. With the object of securing satisfactory new varieties, crosses have been made, and an extensive area has been laid down to seedling black currants.

The main objects of the crosses are the production of :—

1. A late fruiting variety of black currant, so as to prolong the season.

2. A variety with a comparatively hard skin which will stand transport without injury.

3. Late blossoming varieties of merit.

4. Varieties not liable to "run," *i.e.*, to lose their fruit.

5. Varieties resistant to the attacks of the Black Currant Mite (*Eriophyes ribis*).

The varieties from which the actual crosses have been made are Westwick Champion, Carter's Champion, Boskoop, Victoria, and Baldwin, while one or two other varieties have been introduced which it is unnecessary to mention.

The product of each cross has been carefully raised, every seedling being grown and kept separate from the other crosses, and at the end of two years the seedlings have been planted out in their permanent fruiting positions.

Six acres of the best fruit land have been devoted to the growing of the seedlings, which are planted at the rate of 1,000 to the acre. They are manured and cultivated in the same way. During the first winter (December) the young bushes are all cut hard back to within 6 in. of the ground.

The first batch of seedlings was planted out in 1913; strong young bushes have now been obtained and this year a crop of fruit may be expected.

Great differences are apparent in the bushes, the colour of the wood, the foliage, and the habit of growth all varying.

Care has been taken to ensure that the exact parentage of every promising cross can be traced. Spare cuttings were saved when the bushes were headed back, and these were inserted in rows and carefully numbered to correspond with the plant in the fruiting brake. Thus whenever a seedling of promise is observed a considerable stock is already available for purposes of propagation.

Pears.—Commercial pear growing is also most successfully carried out at Westwick. Doyenné du Comice, which is not surpassed for quality, is grown exceptionally well, and although cultivated on a commercial scale the fruit is as large as in trees grown in private gardens.

The Doyennés are very successfully mated with Glout Marceau, pollination not being left to chance. Every year as soon as a fair amount of blossom has opened on both varieties, boys are employed to secure cross-pollination; for several hours each day they gently brush the blossoms with rabbits' tails fixed on slender bamboo canes. In this way they liberate and carry the pollen from the one variety to the other. The results obtained over a series of years amply justify this extra attention and expense.

Adulteration of White Clover Seed.

ABOUT a year ago the attention of the Board was directed to the fact that seeds of Clustered Clover (*Trifolium glomeratum*) were being offered from New Zealand for sale in this country, and that there was a possibility of their being sold as white clover to English farmers by seed merchants, either alone or mixed with genuine white clover.

A sample of the seeds mentioned was examined at Kew, and some of the seeds were sown. The bulk proved to be clustered clover with (among others) one or two seeds of suckling clover (*T. minus*), which is never sown in this country and which is regarded on the Continent as a weed in clover samples. A further species which has been used as an adulterant in New Zealand and which may, therefore, be present in samples of white clover of New Zealand origin, is small-flowered clover (*T. parviflorum*). An account of the seed of this variety as a weed seed in white clover has already been given in this *Journal*.*

T. glomeratum is an annual clover having little or no value. Its usual habitat is by the side of the roads and along the borders of open pastures, and there is no record of its ever having been in cultivation here. The species has spread over considerable areas in New Zealand in recent years, large quantities of the seed being frequently extracted in the cleaning of rye grass and other pasture seeds. The Department of Agriculture of New Zealand have found numerous instances of the deliberate adulteration of white clover seed with the seed of clustered clover, the latter being present in quantities of from 15 to 40 per cent. of the whole sample. Such adulteration is easy, as the seed of clustered clover sufficiently resembles that of white clover to pass unnoticed in the absence of careful examination; and the fact that the addition of clustered clover seed to the average sample of white clover seed improves the colour of the latter has even been taken advantage of to secure a higher price.

The following description of the seeds of clustered clover has been given in the *New Zealand Journal of Agriculture* (Vol. IX. No. 5):—

Shape: Inclined to be heart-shaped; sides somewhat flattened, but more rounded than white clover (*T. repens*) and small-flowered clover (*T. parviflorum*).

Surface: Of comparatively uniform colour; almost the same shade as the lightest yellow seeds of *T. repens*. Each face marked slightly with a groove. The surface is decidedly dull, being finely roughened, a character which, together with its smaller size, facilitates the identification when mixed with *T. repens*, the surface of which is very smooth to slightly shining.

* For the description of white clover (*T. repens*) and small-flowered clover (*T. parviflorum*) see *Journal*, July, 1911, p. 323.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

Lime Requirements of Certain Soils (*Jour. Agric. Sci.*, March, 1915; *H. B. Hutchinson and K. MacLennan*).—This paper deals with the lime requirements of certain soils (*a*) for sterilisation purposes, (*b*) for neutralisation purposes.

Sterilisation.—Calcium oxide (caustic lime) can produce partial sterilisation effects but not calcium carbonate (chalk, limestone, marl, etc.).

The amount of lime necessary to produce specific effects in different soils has been found to vary greatly and it is not possible to make any general recommendations. The method proposed for indicating the critical amount required is based on the determination of the amount necessary for the production of an alkaline reaction of the soil water; the amounts thus indicated agree very closely with those required for the production of typical partial sterilisation effects in the soil itself, *e.g.*, the inhibition of protozoa and nitrifying organisms. The amount of lime thus indicated not only gives the maximum production of dry matter in the *first* crop following treatment, but also in the first *four* crops.

Certain physical changes also occur about the partial sterilisation point.

Neutralisation.—The method described for the determination of the lime requirements of the soil is based on the absorptive capacity of the soil for calcium carbonate, this method having the advantage that no absorption is indicated in the case of neutral soils. An application of carbonate to a soil exercises a marked effect in accelerating the process of ammonification, and, to a lesser degree, nitrification; soils showing a positive lime requirement according to the proposed method have been found to respond distinctly to the application of carbonate (*a*) by increased ammonia and nitrate production in laboratory experiments, and (*b*) by greater plant growth in pot culture and field work.

The values of calcium oxide and carbonate have been shown to be identical provided that the lime requirements for neutralisation purposes are not fully satisfied. After the neutral point is reached calcium oxide exercises its specific effect (see *sterilisation* above).

In the case of soils on the same geological formation a definite relation between soil reaction and natural flora has been traced. The occurrence of certain plants on acid soils appears to be determined by their capacity of resistance to acidity.

FIELD CROPS.

Linseed: Effect of Certain Factors on the Oil Content (*Jour. Agric. Sci.*, March, 1915; *J. Vargas Eyre, M.A., Ph.D., and E. A. Fisher, M.A.*).—The inference is drawn from experiments that, given the most suitable variety and an average season, linseed growing in this country is a profitable undertaking; further, that the only difference between the seed from the fibre crop and that from the

* A summary of all reports on agricultural experiments and investigations recently received is given each month. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.

linseed crop is one of yield, there being little difference in oil content between the two kinds, so that, by harvesting early, the best quality fibre may be obtained without materially lessening the oil content and consequently the value of the seed, little being gained as regards oil content by allowing the seed to ripen before harvesting the crop.

Trials carried out by various agricultural colleges in England in 1913, an average season, indicated that linseed grown in England is by no means inferior in oil content to imported samples of the same varieties. As regards yield of oil per acre the varieties tested took, on the whole, the following order :—(1) Plate, (2) Steppe, (3) Moroccan, (4) Dutch. With the same variety an increase in the oil content was accompanied in practically all cases by an increase in the size of seed. No support was given to the view that repeated growth of linseed from the same stock gives rise to a seed of diminished oil content. The use of artificial manures was found to cause only a very slight variation in the oil content, the main effect produced being in respect of yields of seed and straw.

Linseed: Varieties and Cost of Growth (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Four varieties of linseed were sown after seeds on a clean sandy loam, the manuring given being 3 cwt. superphosphate and 1 cwt. sulphate of potash per acre. The rates of seeding were as follows, per acre :—Morocco 112 lb., River Plate 80 lb., Russian (Steppe) 72 lb., and Dutch 92 lb. The yields of seed, straw, and chaff were, per acre :—

—	Seed.		Straw.		Chaff.	
	Cwt.	lb.	Cwt.	lb.	Cwt.	lb.
Morocco	14	58	21	26	12	56
River Plate	16	96	21	11	7	66
Russian (Steppe)	15	96	21	11	7	54
Dutch	10	64	31	18	8	30

Some trouble was experienced in cutting and tying the Morocco and Dutch varieties owing to the shortness of the straw of the former and the length and tangled nature of the stems of the latter.

The cost of growing the crop was found to be £6 15*s.* 5*d.* per acre, the chief items being rent, &c., £1 15*s.*, ploughing 12*s.*, artificials £1 1*s.* 4*d.*, seed 16*s.*, weeding 6*s.*, cutting 6*s.*, tying 5*s.* (about half were hand-tied), carting and stacking 8*s.*, and threshing £1.

Experiments with Mangolds (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—*Varieties.*—The average results over the three years 1912–14 were as follows (per acre) :—Yellow Globe, 23 tons 12 cwt. ; Long Red 22 tons 4 cwt. ; Red Intermediate, 21 tons 6 cwt. ; Sugar Mangel, 20 tons 3 cwt. ; Yellow Intermediate, 20 tons 3 cwt. ; Golden Tankard, 18 tons 11 cwt. In addition to its cropping powers, Sugar Mangel was shown by analyses to be of higher quality than the other varieties.

Manuring.—These experiments were carried out on three farms (one on a heavy clay soil, the other two on a light loam) during three seasons with Yellow Globe Mangolds. The average results per acre were as follows (15 tons of farmyard manure were given in all cases) :—

Manure.	Yield.	Profit.
	t. cwt.	£ s. d.
1. No artificials	16 1	—
2. 2 cwt. nitrate soda	19 12	1 12 3
3. 2 cwt. nitrate soda + 3 cwt. superphosphate + ½ cwt. steamed bone flour	20 17	2 1 0
4. As on plot 3 + 3 cwt. kainit	19 2	0 17 3
5. As on plot 3 + ¾ cwt. sulphate of potash + 3 cwt. salt	20 13	1 6 0
6. ¾ cwt. sulphate of ammonia, + 1 cwt. nitrate of soda + 3 cwt. superphosphate + ¾ cwt. sulphate of potash + 3 cwt. salt + ½ cwt. steamed bone flour	21 12	2 0 3
7. 2 cwt. nitrate of soda + 3½ cwt. basic slag + 3 cwt. kainit + ½ cwt. steamed bone flour..	19 8	0 11 9

The increases in the yield of mangolds were valued at 15*s*. per ton.

Manuring of Mangolds and Swedes on Poor Arable Land (*Hereford Educ. Com.*).—The demonstration was carried out on poor high-lying arable land, which had not yielded a paying crop for many years. The soil was clay loam, wet in places, deficent in lime and infested with weeds. Six plots, each one-sixth of an acre in extent, were laid out, three for mangolds and three for swedes. All plots received about 15 loads of dung per acre. The further treatment and the results obtained were as follows (per acre) :—

Manure.	Yield.	Profit.*
Mangolds :	tons cwt.	£ s. d.
1. No artificials	12 19	—
2. 1 cwt. nitrate of soda, ½ cwt. sul. am., 3 cwt. super., ¾ cwt. sul. pot., 3 cwt. salt ..	19 0	1 17 7
3. As on 2 + 30 cwt. cob lime	23 17	3 13 6
Swedes :		
1. No artificials	14 4	—
2. ½ cwt. nitrate of soda, 4 cwt. super., 2 cwt. kainit	19 6	1 6 6
3. As on 2 + 30 cwt. cob lime	23 0	2 1 6

* Increased yield of mangolds valued at 12*s*. per ton and of swedes at 10*s*. per ton.

Manuring of Mangolds (*Hereford Educ. Com., Farmer's Bull. No.* 9).—A mixture of ½ cwt. sulphate of ammonia, 3 cwt. superphosphate, ½ cwt. sulphate of potash and 2 cwt. salt per acre applied at seeding time with 1½ cwt. nitrate of lime applied as top dressing shortly after singling gave the largest increase of mangolds in these trials and left the greatest profit. Almost as good results were obtained with the above mixture, but using nitrate of soda (1 cwt.) as top dressing. The following table shows the various schemes tried and the results per acre (average of eight centres) :—

Manure.	Yield.	Profit.*
	tons cwt.	£ s. d.
1. No artificials	26 11½	—
2. ½ cwt. sulph. amm., 3 cwt. super., ½ cwt. sulph. pot., 2 cwt. salt	30 10	18 11
3. As on 2 + 1 cwt. nitrate of soda	34 3¼	2 16 3
4. As on 2 + 140 lb. nitrate of lime	34 10	2 19 9
5. 1 cwt. nitrate of soda, 62 lb. nitrolim, 3 cwt. super., ½ cwt. sulph. pot., 2 cwt. salt ..	32 17½	2 1 5
6. 1 cwt. nitrate of soda, ½ cwt. sulph. amm., 4½ cwt. basic slag, ½ cwt. sulph. pot., 2 cwt. salt	32 16½	2 0 2

* Increased yield of mangolds valued at 12*s*. per ton.

Manuring of Turnips (*Jour. Dept. of Agric. and Tech. Instr. for Ireland*, January, 1915).—The results of both the old and new series of experiments, commenced in 1901 and 1908 respectively, by the Irish Department of Agriculture, are taken to indicate:—

(1) That though good crops of turnips may be grown with dung alone, it is not economical to apply heavy dressings.

(2) That a medium dressing of dung (from 10 to 15 tons per acre), supplemented by from 4–6 cwt. per acre of superphosphate or basic slag, is better than a heavy dressing of dung alone, superphosphate and basic slag being of practically equal value as manure, but basic slag being preferable where lime is deficient or finger-and-toe prevalent.

(3) That of the three kinds of artificial manures phosphatic manures alone materially increase the yield. When a medium dressing of dung supplemented by superphosphate or basic slag is used it is doubtful whether the addition of either sulphate of ammonia or kainit or both will pay; without dung, however, a dressing of 4–6 cwt. superphosphate or basic slag, 1 cwt. sulphate of ammonia and 3 cwt. kainit per acre is recommended.

Manurial tests on peaty soils have shown that superphosphate and basic slag are of practically equal value and that satisfactory returns are obtained from artificials alone.

Manuring of Swedes (*Northants C.C., First Ann. Rept. on Field Expts.*, 1914).—On a limestone brash soil the highest yield was given by a complete artificial manure, in trials both with and without farmyard manure. On a light loam none of the artificials were very effective in increasing the yield over that obtained by the application of farmyard manure alone; but growth was hindered by lack of moisture and the crop was evidently unable to make use of the extra plant food supplied.

At two further centres slag was compared with superphosphate; on a light loam very poor in lime and affected with finger-and-toe, slag, whether used alone or with kainit and sulphate of ammonia, produced a larger quantity of roots, and sounder roots than superphosphate; on a clay loam very rich in lime, superphosphate proved the better source of phosphate.

Fish manure containing 8·5 per cent. phosphate and 1·4 per cent. nitrogen was tried for swedes on a light loam; the conclusion was reached that it was a mistake to use this manure at £3 10*s*. per ton when a mixture containing the same amount of nitrogen and phosphate in a form probably more suitable for ordinary farm crops can be made up for less than £2 per ton.

Manuring of Swedes (*Jour. Univ. Coll. of Wales, Agric. Dept.*, 1914).—The experiments were carried out in North Cardiganshire on small plots. The soil was light, stony, dry and rather shallow. Superphosphate proved more suitable than basic slag when applied alone, but given with a medium quantity of farmyard manure there was very little difference between the two. Kainit and sulphate of ammonia were beneficial with superphosphate but not without superphosphate, thus showing the soil to be deficient in available phosphates.

Manuring of Potatoes (*Lindsey C. C. Educ. Com., Bull. No.* 3, 1914–15 ; *R. N. Dowling, N. D.A.*).—The advantage of mixing manures on the farm over buying compound manures was shown by this experiment, carried out on "Royal Kidney" potatoes on a deep alluvial loam, the plots varying from one-sixth to one-half an acre in size. To begin with, analysis demonstrated that the compound manures used were priced at about £2 to £2 10*s.* per ton more than they were worth. The dressings used, the yields of saleable potatoes, and the financial results were as follows (per acre) :—

	Manure.	Yield.		Cost of Manures.			Profit (+) or Loss (—)		
		tons	cwt.	£	*s.*	*d.*	£	*s.*	*d.*
1.	1 cwt. sul. am. 4 cwt. super. .. 1 cwt. sul. pot.	8	11	1	13	0	(+) 7	11	6
2.	1 cwt. sul. am. 4 cwt. super ..	8	8	1	3	0	(+) 7	13	9
3.	1½ cwt. nit. soda 4 cwt. super. .. 1 cwt. sul. pot.	8	0	1	15	0	(+) 5	12	0
4.	No manure	5	18	—			—		
5.	"A" compound ..	6	2	1	19	0	(—) 1	3	3
6.	"B" compound ..	6	9	1	19	6	(—)	1	0
7.	"C" compound ..	7	1	2	0	6	(+) 2	0	0

Manuring of Potatoes (*Northants. C.C. First Ann. Rept. on Field Expts.*, 1914).—The trial was carried out on a medium loam, with the variety Up-to-Date, the previous crop being wheat. The result emphasised the importance, especially in the absence of farmyard manure, of using a complete mixture of artificials for the potato crop. A profit of £6 16*s.* 9*d.* per acre was obtained from the use of 4 cwt. superphosphate, 2 cwt. sulphate of ammonia, and 1½ cwt. sulphate of potash per acre (the increased yield was valued at 50*s.* per ton). Omitting any one of these ingredients substantially reduced the profit.

Change of Seed Potatoes (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—Tests extending over three years showed change of seed to be of considerable importance. The same results were obtained in the three years as to order of cropping power of seed from various sources which was as follows :—(1) Sligo ; (2) Perth ; (3) Lincoln ; (4) Saffron Walden ; (5) Local (Chelmsford).

A further trial was made in 1914 to compare seed obtained direct from Scotland with Scottish seed grown one year and two years in Essex. It was found that in the case of the early, second early and majority of late varieties the seed obtained direct from Scotland produced the larger crops. In the case of Dalmeny Regent, however, seed grown one year in Essex was the superior in cropping power. The Scottish

seed grown one year in Essex was superior to that grown two years in the case of all varieties (four) for which this point was tested ; earlies appeared to lose vigour more readily than the later varieties.

Cultivation Test with Potatoes (*Jour. Dept. of Agric. and Tech. Instr. for Ireland,* January, 1915).—Extensive experiments were carried out to show the advantage of sprouting the seed, manuring and spraying the crop. In one case seed was planted whole direct from the pit, and manured with 20 tons of dung, the crop being left unsprayed ; in the other the seed was sprouted, 6 cwt. of artificials was given in addition to the dung and the crop was sprayed twice. The increased crop due to these improved methods was over 4 tons of saleable tubers per acre on the average of 31 centres.

Manuring of Hops (*Hop Manuring Experiments, Report for* 1914, *Dr. Bernard Dyer*).—The well-known experiments on the continuous manuring of hops carried out by Mr. Shrivell and Dr. Bernard Dyer at Golden Green, Hadlow, Tonbridge, have been reviewed in this *Journal* from time to time (see issue for March, 1914, p. 1104). The following table gives the results up to date :—

Plot.	Annual Manuring per Acre.	1913 Crop.	1914 Crop.	19 Years' Average, 1896–1914.
		Cwt.	Cwt.	Cwt.
A	Phosphates and potash	7¾	9½	10¼
B	Phosphates, potash, and 2 cwt. nitrate of soda	10¾	14½	13¼
C	Phosphates, potash, and 4 cwt nitrate of soda	15	18¾	16
D	Phosphates, potash, and 6 cwt. nitrate of soda	15	20½	15¾
E	Phosphates, potash, and 8 cwt. nitrate of soda	15½	22¼	17
F	Phosphates, potash, and 10 cwt. nitrate of soda	15½	21¾	16¾
X	Thirty loads (15 tons) London dung	14¾	19¼	15¼

Composition of Wheat and its By-Products (*Jour. Dept. Agric. and Tech. Instr. for Ireland,* April, 1915 ; *H. Hunter, B.Sc.*).—In 1908 the Department of Agriculture and Technical Instruction for Ireland commenced a series of experiments to ascertain the agricultural and milling values of Red Fife, Squarehead's Master, White Queen, and White Stand Up Wheats. The general composition of wheat grain, flour, bran, pollard and germ meal, as shown by the figures obtained is as follows (on dry matter) :—

—	Oil.	Albuminoids.	Carbohydrates.	Fibre.	Ash.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Wheat grain ..	2·00	13·75	80	2·5	1·75
Flour	·75	12·75	86	0·0	·50
Bran	4·00	15·00	61	12·0	7·00
Pollard ..	4·50	16·00	68	5·5	4·00
Germ meal ..	7·00	22·00	62	2·7	4·20

Differences in the composition of the grain of the four wheats were shown to exist and to be the direct cause of differences in the flour and offals obtained after milling.

The composition of bran is largely dependent on the extent to which the skin of the grain is capable of being cleaned of closely adhering endosperm.

The composition of pollard is determined mainly by the amount of bran abstracted and the extent to which this is replaced by flour.

In these investigations the composition of the grain of the four varieties was unaffected by differences of soil and geographical position of the experimental centres.

There was no difference in the composition of the bran and pollard, of the two red wheats (Red Fife and Squarehead's Master) and two white wheats (White Queen and White Stand Up) dealt with.

In some cases the germ meal is not separated from the bran and pollard during milling, when, on account of its richness in oil and albuminoids the proportion in which it occurs in these two products must exert a considerable effect on their ultimate composition.

Varieties of Wheat (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Seed of a number of varieties of wheat was sown at the rate of 2¼ bushels per acre between October 17th and 22nd. The yields per acre (1) of grain in bushels, and (2) of straw in cwt., for each variety, were as follows:—Rivett's, 49¾, 52; Browick Grey Chaff, 44½, 32¼; Snowdrop, 44, 44¼; Svalöf Extra Square Head, 41¼, 39¾; Wilhelmina, 41, 41½; Squarehead's Master, 40½, 40¾; White Chaff Square Head, 40½, 36½; Standard Red, 39, 39¼; Regenerated Squarehead's Master, 38½, 35½; Browick Grey Chaff, 38½, 35½; White Chaff Square Head, 37¾, 35¾; Champion, 37¾, 33¾; Red Chaff Square Head, 37½, 34; New White Wheat, 35¼, 34¼; Essex Square Head, 35¼, 30¼; Victor, 33½, 30¼; Svalöf Grenadier, 30½, 28.

Varieties of Wheat (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Trials of varieties of wheat were carried out at 14 centres in Shropshire, Staffordshire and Warwickshire on a number of different soils. The average yields in bushels per acre in 1914 at the 14 centres were:—Svalöf Squarehead, 41·83; Wilhelmina (5 centres), 40·90; Little Joss, 37·86; Squarehead's Master, 37·49; Browick Grey Chaff, 37·36; Standard Red, 36·89; White Chaff Squarehead (9 centres), 36·03.

Rate of Seeding of Wheat (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Five rates of sowing wheat seed were tried, the plots being drilled on October 17th with the variety Squarehead's Master. The different rates of seeding per acre and the yields per acre obtained were as follows:—(1) Seed 3 bush., grain 35¼ bush., straw 43 cwt.; (2) seed 2¾ bush., grain 41¾ bush., straw 48½ cwt.; (3) seed 2½ bush., grain 47 bush., straw 49¾ cwt.; (4) seed 2¼ bush., grain 47 bush., straw 45½ cwt.,; (5) seed 2 bush., grain 47¼ bush., straw 47¼ cwt. The medium seedings gave better results than the thick, and the figures on the whole bear out the results obtained in 1913.

Egyptian Wheats (*Bull. Imp. Inst.* January-March, 1915).—In order to ascertain the suitability of Egyptian wheats for export to the United Kingdom, four samples stated to be representative of the wheats grown in Egypt were submitted by the Imperial Institute for examination. Of these the following three proved suitable for the British market: (1) *Hindi* wheat, similar to Muzaffarnaggan Indian

wheat, estimated value 51*s.* per qr. of 492 lb. (December 10th, 1914); (2) *Saidi*, a wheat of good colour, but rough, thin-skinned, starchy and lacking strength, worth about 49*s.* 6*d.* per 492 lb. (December 10th, 1914); and (3) *Beheri*, a large berried but very rough wheat, thin skinned, starchy and lacking strength, worth about 48*s.* per 492 lb. (December 10th, 1914). A fourth sample representing a type known as "Gawi" was found to be unsuitable.

Varieties of Barley (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Twelve varieties of barley were tested in 1914 on a heavy loam soil in good condition. The yields per acre of (1) grain in bushels, and (2) straw in cwt. were as follows:—Svalöf Gold, 59, 26¾; Princess 56, 35¾; Maltster, 53, 27¼; Archer's Stiff Straw, 52¼, 35; Standwell (Garton's) 52, 32¾; Goldthorpe, 50, 28¾; Burton Malting, 49½, 31½; Plumage, 49¼, 34; Standwell (College seed), 48½, 35¾; Svalöf Hännchen, 45½, 33½; Svalöf Swan Neck, 38¾, 23; Primus, 38¼, 21.

Rate of Seeding of Barley (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Barley sown at the rate of 150 lb., 168 lb., 183 lb., and 200 lb. per acre produced respectively 56¾, 56½, 55 and 56¾ bushels of grain and 34, 34¼, 28¾ and 35½ cwt. of straw per acre.

Varieties of Oats (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Twelve varieties of oats were drilled at the rate of 4¼ bushels per acre on a sandy loam. The yields per acre of (1) grain in bushels, and (2) straw in cwt. were as follows:—King's New White Oat, 88¼, 38; Svalöf Victory, 85¼, 40¼; Leader No. 1, 85, 31¾; Abundance No. 1, 84¾, 35½; Abundance (New Zealand), 84½, 34½; Thousand Dollar, 84, 33¼; Leader No. 2, 83, 30; Garton's New Black Oat, 80, 32¼; Leader, 78½, 30¼; Abundance, 74¼, 33; Abundance No. 2, 67¾, 36½; White Horse, 61¾, 26.

Rate of Seeding of Oats (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—In order to test the rate of seeding oats, 5 plots were drilled with Leader oats in varying quantities. The rates of seeding per acre and the yields per acre obtained were as follows:—(1) Seed 100 lb., grain 95 bush., straw 37 cwt.; seed 120 lb., grain 100 bush., straw 36½ cwt.; seed 160 lb., grain 101 bush., straw 38¾ cwt.; seed 200 lb., grain 94 bush., straw 37½ cwt.; seed 240 lb., grain 95½ bush., straw 41½ cwt.

Manuring of Grassland for Meat and Milk (*Rept. on Field Expts, at Harper Adams Agric. Coll.*, 1914).—This test was started in 1911*. The three plots concerned, each of 3½ acres, have been annually manured per acre as follows:—Plot I., 2½ cwt. of superphosphate, costing 8*s.* 4*d.* per acre; Plot II., 2½ cwt. of superphosphate and ½ cwt. of sulphate of potash, costing 13*s.* 11*d.* per acre; Plot III., no manure.

In 1914 the dressings were applied on February 18th, and on May 18th two dairy cows were put on each plot for twenty weeks, the surplus herbage being consumed by yearlings.

The yield and total value of the milk obtained from the cows were as follows:—Plot I., 673 gal., £16 4*s.* 4*d.*; Plot II., 737 gal., £17 15*s.* 8*d.*; Plot III., 668 gal., £16 1*s.* 9*d.*

The value of the keep of the yearlings was reckoned at 1*s.* 3*d.* per week, and on this basis the grazing on the various plots was worth:—Plot I., £2 4*s.* 5*d.*; Plot II., £2 7*s.* 6*d.*; Plot III., 17*s.* 6*d.* The total

* The results for 1912 and 1913 are given in this *Journal* for March, 1914, p. 1102, and July, 1914, p. 339, respectively.

increases in live weight were from Plot I., 2 cwt. 3 qr. 17 lb., from Plot II., 3 cwt. 25 lb., and from Plot III., 1 cwt. 1 qr. 10 lb.

Combining the above figures, the net returns, after deducting the cost of the manures, and ignoring the increase in weight of the yearlings, were : *Plot I., £16 19s. 7d. ; Plot II., £17 14s. 5d. ; Plot III., £16 19s. 3d.*

Manuring of Meadow Land (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Experiments were commenced in 1903 in order to determine various points in connection with the application of farmyard manure and artificials to grassland. The soil was a stiff clay loam, resting upon a bed of clay overlying the red sandstone. The manures, with the exception of the dung, were applied each year, and the plots were mown and grazed annually. The results per acre of the 12 years' manuring are given in the following table :—

Plot.	Manures applied annually.	Cost of manures for 12 yrs.	Total yield for 12 yrs.	Value of increase at 50s. per ton	Net profit for 12 yrs.
		£ s. d.	t. c. lb.	£ s. d.	£ s. d.
1	No manure	—	12 17 4	—	—
2	1¼ cwt. nit. of soda ; 2½ cwt. super. ; ¾ cwt. sulph. of pot.	13 16 6	22 15 59	24 16 3	10 19 9
3	As 2, omitting sulph. of pot.	11 11 6	21 18 94	22 14 6	11 3 0
4	As 2, omitting super.	9 11 4	15 15 58	7 6 3	2 5 1 (loss)
5	As 2, omitting nit. of soda	6 9 2	20 9 38	19 0 10	12 11 8
6	10 tons dung (1903, 1907 and 1911) ..	7 10 0	19 4 28	17 3 0	9 13 0
7	As 6, with complete artificials in intervening years ..	17 19 7	23 5 78	16 1 8	1 17 11 (loss)
8	1¼ cwt. nit. of soda..	7 7 4	15 11 66	6 16 4	0 11 0 (loss)
9	2½ cwt. super. ..	4 6 10	19 5 108	16 2 6	11 15 8
10	¾ cwt. sulph. of pot.	2 4 0	13 16 0	2 7 6	0 3 6 (loss)

The yield and value of the produce is stated only for that portion of the crop which was removed as hay.

Artificials were not profitable, when combined with an application of farmyard manure once in four years, though they considerably increased the yield. The residual effect of the dung on Plot 6 was clearly defined during each period of 3 years when no manure was applied. The leading requirement of the herbage on this soil was clearly shown to be phosphate.

In 1911 each plot was divided into two equal portions and 10 cwt. of lime per acre was applied to one-half, the other receiving no lime. The effect was most marked on those plots receiving superphosphate while with nitrate of soda and sulphate of potash the effect was negligible.

A further test was carried out to compare the effect of potassic superphosphate, superphosphate and kainit on a stiff clay loam soil. The results per acre were as follows :—

Plot.	Manures applied.	Cost in 1914.	Average yield. 1911-14.
		s. d.	cwt. lb.
1	365 lb. super. and 81 lb. kainit.. ..	12 11	23 98
2	4 cwt. potassic super.	16 0	25 19
3	365 lb. super.	10 10	22 84
4	No manure	—	21 3
5	365 lb. super. and 70 lb. nit. of lime ..	17 1	24 98

Liming of Grass Land (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—The field used was an old pasture, grazed for many years by cattle receiving a good allowance of cake. Lump lime applied for 3 years at the rate of 18¾ cwt. per acre per annum caused an average annual increase in hay of 7¼ cwt. at a cost of 8½*d.* per cwt.; ground lime at the rate of 15 cwt. per acre gave an average increase of 5½ cwt. at a cost of 11¼*d.* per cwt.; and ground limestone at the rate of 22½ cwt. per acre caused an average gain of 4¼ cwt. at a cost of 1*s.* 1¾*d.* per cwt.

Manuring of Meadow Hay (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—Four plots were taken. Plot I. was unmanured; Plot II. received 5 cwt. of steamed bones in 1912; Plot III. received 5 cwt. of superphosphate in 1912 and 1913; Plot IV. received 2½ cwt. of steamed bones in 1912 and 1913. No manures were applied in 1914. The average annual yields for the 3 years 1912 to 1914 were: Plot I., 26 cwt. 98 lb.; Plot II., 29 cwt. 103 lb.; Plot III., 31 cwt. 33 lb.; Plot IV., 28 cwt. 83 lb.

Tobacco Growing in Ireland (*Jour. Dept. Agric. and Tech. Instr. for Ireland*, April, 1915).—These experiments were last summarised in this *Journal* for April, 1914, p. 58. The following table shows the results obtained in 1913:—

—	Pipe (average of 6 centres).	Pipe and Cigarette (one centre).
Average yield per acre in lb. ..	916	1,048
Cost of production, per lb.	8·4*d.*	6·1*d*
Amount received, per lb.	5·0*d.*	6·3*d.*
	£ s. d.	£ s. d.
Cost of production, per acre ..	32 1 4	26 11 0
Amount received, per acre	19 0 5	27 12 2

Rotation Experiments (*E. Suffolk County Educ. Com. Rept. on Field Expts., Circ.* 15, 1915).—A rotation consisting of (1) roots, (2) barley, (3) beans, peas or clover, and (4) wheat, has been tested for 15 years, the land being arranged in four sections so that each crop of the rotation is grown every year. The same schemes of manuring have been carried out with each crop each year. Particulars of the results for each crop for each combination of manures over the whole 15 years are given in the Report.

The greatest net profit has been obtained from the use of a dressing of 2 cwt. superphosphate and 2 cwt. nitrate of soda to each crop each year; the net gain was practically £1 per acre per annum over the 15

years. The net profits from (*a*) 2 cwt. superphosphate alone and (*b*) 2 cwt. superphosphate combined with 2 cwt. nitrate of soda and 1 cwt. muriate of potash were not very much inferior. Farmyard manure at the rate of 6 tons per annum gave a net gain per annum of 16*s*. per acre. Dressings of 4 cwt. bone meal and of 2 cwt. superphosphate and 1 cwt. muriate of potash also gave profits. Nitrate of soda and muriate of potash, either alone or in combination, resulted in losses.

The above four-course rotation has been carried out on another field for five years, but the manuring adopted has varied with the crop. In this experiment comparatively good yields of corn have been obtained from the plot receiving no manure throughout the rotation. Of the various combinations tried, that giving the largest profit was 10 tons dung and 1 cwt. nitrate of soda to wheat, 1 cwt. nitrate of soda to barley, and 1 cwt. nitrate of soda and 5 cwt. superphosphate to roots; as nearly as large a profit was obtained when the nitrate of soda was omitted from the wheat and root dressings. Where, however, the dressing given to the whole rotation has been 10 tons dung, 1 cwt. nitrate of soda and 5 cwt. superphosphate it has proved better to give the dung to the roots and the artificials to the wheat, than *vice versâ*.

Varieties of Lucerne (*East Anglian Inst. of Agric., Rept. on Field Expts*., 1914).—The plots were sown on May 11th and the amount of green fodder cut on September 4th was: Chinese lucerne, 6 tons 3½ cwt.; Provence lucerne, 4 tons 6½ cwt.; Turkestan lucerne, 3 tons, 14 cwt. per acre. In 1912, Chinese lucerne yielded 8 tons 1 cwt. and Provence lucerne 6 tons 4 cwt. of green fodder per acre.

Growth of Millet and Sorghum (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—Millet (*Sorghum vulgare*) was drilled on May 14th at the rate of 20 lb. per acre in rows 7 in. apart; the crop reached 7 ft. in height and remained erect. It yielded 22¾ tons of green fodder per acre when cut on August 17th. The crop is useful as giving an early supply of green fodder in dry seasons; the seed costs about 3d. per lb.

A small plot of *Sorghum saccharatum* sown on May 14th produced 25 tons 6 cwt. of green fodder per acre.

Doura (yellow branching) and white Kaffir corn, plants similar to sorghum and millet, produced 19 tons 3 cwt. and 23 tons 9 cwt. per acre respectively of green fodder.

Growth of Maize (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—*Varieties.*—The seed was ploughed in on May 26th in rows 20 in. apart, at the rate of 2 bushels per acre; the land received, in addition to 15 loads of farmyard manure, ¾ cwt. sulphate of ammonia, 3 cwt. superphosphate and ¾ cwt. sulphate of potash, while ½ cwt. nitrate of soda was given as a top dressing. The yield of green fodder per acre was as follows:—Improved Leaming, 29 tons 4 cwt.; Eureka, 27 tons 10 cwt.; White Horse Tooth, 27 tons 1 cwt.; Improved Horse Tooth, 26 tons 19 cwt.; Wood's Northern Dent, 26 tons 10 cwt.; White Cap Yellow Dent, 23 tons 15 cwt.; Longfellow, 23 tons 13 cwt.; Giant Caragua, 23 tons 7 cwt.; Rural Thoroughbred White Flint, 22 tons 10 cwt.; Evergreen Sweet Fodder, 16 tons 5 cwt. Similar tests were carried out in 1912 and 1913, and the results of the three years' experiments have shown the American varieties, Improved Leaming, Eureka and Wood's Northern Dent to be heavy yielders of green fodder.

Distance between the Rows.—The greatest yield was obtained with rows 8 in. apart and the yield diminished as the distance between the

rows was increased. With the narrow distance the conditions would, however, be unfavourable to subsequent thorough cleaning and stirring of the soil, in addition to rendering necessary more seed.

Experiments with Green Crops (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—The relative cropping powers and the effect of the time of sowing on the yield were determined, with the following results (per acre) :—Kohl Rabi (sown on April 16th), 24 tons 19¼ cwt., (sown on April 29th) 21 tons 17¾ cwt. ; Marrow-stem Kale, 24 tons 16¾ cwt., 20 tons 12¾ cwt. ; Cabbages, 22 tons 4 cwt., 20 tons 11 cwt. ; Swedes, 18 tons 10½ cwt., 11 tons 7¼ cwt. Marrow-stem Kale is the result of a cross between Thousand-headed Kale and Kohl Rabi ; stock eat the stem with avidity. The larger yields resulting from the earlier sowing are attributed to dry weather supervening between the two sowing dates.

Varieties of Picking Peas (*East Anglian Inst. of Agric., Rept. on Field Expts.*, 1914).—The peas were sown on April 4th and picked in the first and second weeks in July. The following were the yields of pods (in bushels per acre) :—Essex Star 374, Telegraph 345, Gradus 321, Pilot 302.

LIVE STOCK, FEEDING AND DAIRYING.

Conformation of Cows and Milk Yield.—Recent Continental research has rather tended to throw doubt on the system of judging dairy cows by various "points" of conformation (*e.g.*, see this *Journal*, January, 1914, p. 906). The case for conformation, however, is urged in an article in the *Jahrbuch für wissenschaftliche und praktische Tierzucht*, for 1914, by the director of animal breeding at Königsberg. The reliance placed on conformation by practical men is alluded to, and attention is drawn to the fact that milk "points" develop in the course of lactation. This is the case with udder, milk veins, skin and hair. It is urged that investigators have failed to take sufficiently into consideration the effect of lactation, age, feeding and care of cows.

This investigator therefore carried out an enquiry with cows of one and the same herd and only with animals of four years old, with records extending over three years and with normal lactation. The animals were examined for "points" in May and November and the average of the two awards taken. The animals were then divided into three classes according to "points." Those in class 1 gave 120 gals. more milk per cow per annum than those in class 2, and those in class 2 116 gals. more than those in class 3.

Fluctuations in the Weight of Newly-Born Animals (*Jahrbuch für wissenschaftliche und praktische Tierzucht*, 1914).—While it is a well-known fact that there is a decrease in the weight of children in the first few days subsequent to birth, but little has been done towards investigating whether this phenomenon holds good for animals ; hence these experiments at the Royal Veterinary High School at Dresden with cattle, sheep, goats, and swine.

Of 25 calves, 80 per cent lost weight in the first few hours after birth, the remaining 20 per cent either retaining their original weight or even increasing. The loss in weight averaged 4 per cent, and the net loss in weight reckoned on *all* calves averaged 2 per cent. The period over which the loss in weight extended averaged 21·8 hours ; increase in weight began [illegible] the average after [illegible] hours, or reckoned

on *all* calves, after 30·5 hours. The weight at birth was regained on the average after 61¾ hours, or reckoned on *all* calves after 48·9 hours.

Of 12 *lambs* and 10 *kids*, 60 per cent. lost weight; the loss averaged 4·1 per cent., lasted on the average over 11·6 hours, increase in weight began again after an average of 23·4 hours, and the initial weight was reached again after 40 hours on the average (or after 23·6 hours reckoned on *all* animals).

Newly-born *pigs* showed, in the majority of cases (85 per cent.) increase from birth onwards. With a small minority a decrease in weight began soon after birth, and averaged 3·6 per cent. of the weight, lasted 7 hours and the initial weight was regained after 15·6 hours.

Effect of Condensing and Drying on the Bacterial Content of Milk (*Repts. to Local Govt. Bd. on Public Health and Medical Subjects, Food Repts. No. 21; Dr. S. Delépine*).—Three methods of preservation of milk as practised at four factories in England were investigated, viz.:—(1) manufacture of sweetened condensed milk, (2) drying of milk over heated revolving cylinders, (3) drying by spraying the milk into a current of hot air.

The total number of bacteria present in mixed cows' milk, such as is usually supplied to town consumers, was found to be considerably reduced by treatment according to each of the three methods, the reduction being greatest with (1) and least with (3).

In each of the three methods there was a stage at which the reduction in the total number of bacteria was much greater than that observed in the finished article ready for sale, the increase observed during the final stage being due to recontamination.

At none of the stages of preparation was the milk ever found completely sterile, some saprophytic and pathogenic bacteria being left unharmed; of the latter, tubercle bacilli survived pasteurisation in method (1) and the treatment in method (2) and, therefore, that in method (3). The tuberculosis produced in guinea pigs by these heated bacilli was, however, "latent" or "occult" for some four weeks, and young rabbits fed with milk containing these modified bacilli did not contract tuberculosis.

The Freezing Point of Milk as a Test for Added Water (*Repts. to Local Govt. Bd. on Public Health and Medical Subjects. Food Repts., No. 22; Dr. G. W. Monier-Williams*).—Continental chemists have called attention to the fact that the freezing point of milk varies within comparatively narrow limits. The addition of water to the milk has the effect of raising the freezing point in proportion to the quantity of water added. It is claimed that the value observed for the freezing point affords a more certain and accurate indication of the presence and relative amount of added water in milk than can be obtained from the results of chemical analysis alone.

In this investigation the average freezing point of 141 samples of genuine milk was found to be —0·5345° C., the values ranging from —0·558° C. to —0·514° C. It is concluded that the freezing point of milk appears to be the most constant of any of the properties exhibited by genuine milk. Although unaffected by the removal of fat from, or the addition of separated milk to, genuine milk, it is raised by the addition of water to the milk.

The method may, in certain circumstances, be applied with advantage, as a confirmatory test, to the detection of added water and

to the approximate estimation of the amount present. Owing, however, to the experimental difficulties involved in obtaining reliable results, it is somewhat doubtful whether the method is capable of general application for purposes of milk control.

Ability of Colon Bacilli to Survive Pasteurisation (*Jour. Agric. Research*, February, 1915).—The thermal death point of cultures of colon bacilli isolated from cow fæces, milk and cream, human fæces, flies and cheese showed considerable variation when the cultures were heated in milk for 30 minutes under conditions similar to pasteurisation. At 60° C. 55 per cent. survived, while at 62·8° C. (the usual pasteurising temperature) only 7 per cent. survived; thus the raising of the temperature by the small amount of 2·8° C. was sufficient to kill 87 per cent. of the colon bacilli surviving the lower temperature. The ability of the colon bacilli to survive 62·8° C. was due to the survival of a few cells; when the pasteurised milk is held under temperate conditions which might be met with during storage and delivery of milk these surviving bacilli would be able to develop rapidly.

Only one culture of colon bacilli was not destroyed at 65·6° C. on the first heating, but in repeated experiments it was always destroyed, so that from these results it is not to be expected that any colon bacilli will survive 65·6° C. It is stated, however, that a study of more cultures might reveal strains of colon bacilli that are able to survive this and even higher temperatures.

Removal of Onion Flavour from Milk (*U.S. Dept. of Agric., Farmers' Bull. No.* 608).—When cows eat wild onion within four hours before milking their milk takes on a disagreeable odour and flavour. A process for removing this onion flavour from the milk is described; it consists in blowing air through milk heated to at least 145° F., for from 30 to 60 minutes. A slightly longer blowing period is required in the case of cream.

The Feeding Value of Flax Shives (*Mass. Agric. Expt. Sta., Bull. No.* 158).—Flax shives, sometimes incorrectly called flax bran, consist of ground refuse stalks and pods of the flax plant. They are sometimes used as a component of stock and molasses feed, and have been found on sale in Massachusetts as a substitute for wheat bran. They have the appearance of finely ground hay. Analyses of two samples showed the composition to vary widely; the results, together with the digestibility coefficients obtained in trials with sheep, were as follows:—

	Analyses.		Digestibility Co-efficients.	
	Sample No. 1.	Sample No. 2.	Sheep No. 1.	Sheep No. 2.
	Per cent.	Per cent.	Per cent.	Per cent.
Water	6·8	10·0	—	—
Dry matter..	93·2	90·0	42·94	47·82
Ash	12·1	5·0	21·86	23·69
Protein	6·1	14·9	79·98	82·08
Fibre	45·2	32·3	22·00	29·58
Carbohydrates	27·7	34·9	41·27	45·6
Fat	2·1	2·9	92·26	9·09

It would seem, therefore, that flax shives have a high fibre content and a small amount of protein, and their total digestibility is about 45 per cent. as compared with 66 per cent. for wheat bran.

Manioc Meal, Ground Nut Meal and Maize Gluten Feed for Dairy Cows (*Ann. de la Science Agron.*, July-December, 1914).—The addition of 4 lb. of good quality maize gluten feed to the basal ration of dairy cows was compared with 4 lb. of a mixture of manioc meal and ground nut meal in the proportion of 3 : 2. This mixture was found to be at least equal to the maize gluten feed and to result in a gain of 3*s*. 4*d*. per 220 lb. of concentrated food fed owing to the cheaper prices of ground nut meal and manioc meal as compared with maize gluten feed.

PLANT DISEASES.

Stalk or Sclerotium Disease of Potatoes (*Jour. Dept. Agric. and Tech. Instr. for Ireland*, April, 1915 ; *G. H. Pethybridge, Ph.D., B.Sc.*).—In 1914 the nnmber of plants affected by this disease was found on the whole to diminish with increasing lateness in planting, the reduction being remarkably striking in the plots planted from the middle of May onwards. With early planted potatoes the period at which the rate of infection was greatest was from the first week in Jnly to the first week in August. When, however, planting is delayed to a very late date diminished yields result ; in 1914 the maximum crop on old land was obtained by planting at the beginning of April and on new land a month later.

No case of disease was found in plots of Champion II., Clifden Seedling and Summit.

Potato Blight (*Jour. Dept. of Agric. and Tech. Instr. for Ireland*, April, 1915 ; *G. H. Pethybridge, Ph.D., B.Sc.*).—In 1914 Bordeaux mixture proved superior to Bordeaux paste prepared by combining commercially pure, 99 per cent. sulphate of copper and hydrated, selected lime, in addition to which the cost of the paste was about twice that of the Bordeaux mixture.

Bordeaux and Burgundy mixtures prepared from a 1 per cent. solution of copper sulphate in 1914 produced both a greater total yield of potatoes and a slightly greater yield of healthy tubers as compared with mixtures prepared from a 2 per cent. solution of copper sulphate. The work of past seasons has shown that the differences due to the use of spraying mixtures of the two strengths named are not very great one way or the other.

A Burgundy mixture prepared by precipitating copper sulphate with commercial potassium carbonate instead of the usual sodium carbonate was tested in order to ascertain the effect of combining with the mixture used against the blight a substance which would, if absorbed, be of benefit to the potato plant. The results in 1914 showed a very slight advantage in favour of this potash mixture over the ordinary soda mixture ; the advantage gained would not justify a change from the use of soda to that of the more expensive potash in preparing Burgundy mixture.

Four varieties of potatoes which have a good reputation in England as being resistant to blight, viz., Langworthy, Golden Wonder, Peacemaker and What's Wanted failed to exhibit this character in Irish trials in 1914 at least as regards foliage and stalks, and the yields were small. The varieties Champion II. and Clifden Seedling proved very highly resistant, and Shamrock and Northern Invincible highly resistant to blight.

The result, so far, of planting blighted tubers in the open ground at the ordinary depth common in practice has been that they give rise either to complete " misses " or to healthy plants.

Dusting *v.* Spraying for Potato Blight (*Jour. Dept. Agric. and Tech. Instr. for Ireland*, April, 1915; *G. H. Pethybridge, Ph.D., B.Sc.*).—The efficacy of dusting powder was compared with that of liquid sprays. Three powders were tested: one was composed of fine particles of copper sulphate and dry sodium carbonate (soda) intimately mixed, the second was the dried precipitate formed by treating copper sulphate solution with milk of lime, and the third (" copper oxide hydrate ") was stated to be a by-product in the manufacture of copper. The liquid sprays tested were Bordeaux and Burgundy mixtures at the rate of 100 galls. per acre for the first spraying and 120 galls. for subsequent sprayings. The plots were duplicated, one lot being sprayed or dusted three times, and the other four times.

Compared with Burgundy mixture the first of the above powders led to a loss in total crop, a diminished yield of healthy tubers and an increase in the percentage weight of blighted tubers. Compared with Bordeaux mixture the second and third powders were much less effective in keeping the foliage free from blight, although increased total yields were obtained where the two powders were used, so that there was very little difference in the yield of healthy tubers from the three methods of treatment.

Brown Scab of Potatoes (*Jour. Dept. Agric. and Tech. Instr. for Ireland*, April, 1915; *G. H. Pethybridge, Ph.D., B.Sc.*).—From the experiment described there is practically no doubt that the ordinary or brown scab of potatoes is due to an organism which can be killed by heat; and that mechanical irritation does not cause this scab.

Dusting *v.* Spraying of Apples (*Cornell Univ. Agric. Expt. Sta., Bull* 340).—On account of the difficulty experienced in effectively spraying large orchards in the short time usually available attempts have often been made to replace spraying by dusting, the latter process being simpler and more quickly carried out. The results from dusting have usually been inferior, perhaps owing to the fact that copper preparations have been used.

These experiments were therefore carried out with powdered sulphur preparations against apple scab with results sufficient to warrant further trials. Lead arsenate in powdered form was more effective than in the spray form against the common insects of the orchard. The costs of dusting were greater than those of spraying but the process was much quicker.

NOTES ON AGRICULTURAL CO-OPERATION.

Co-operation in Agriculture in 1913.*

Distributive and Productive Societies.—At the end of 1913 there were 906 registered co-operative societies engaged in agricultural production and distribution in the United Kingdom.

Of these 833 were societies engaged wholly in agricultural operations, 465 being engaged in the distribution of seeds, manures, implements, &c., and 368 mainly in the production of butter. The 833 societies had an aggregate

* *Board of Trade Labour Gazette*, April and May, 1915.

membership of 112,146, or an increase of 4·4 per cent. over the previous year and of 85 per cent. over 1903.

The total capital—share, loan, and reserve—amounted to £1,031,397, or an increase of 12·9 per cent. over 1912, and of 197·1 per cent. over 1903. The aggregate sales of these 833 societies amounted to £6,070,260, an increase of 9·2 per cent. over 1912, and of 256 per cent. over 1903, while the profit amounted to £39,923, a decrease of £11,294 on 1912 and an increase of £33,090 on 1903. They employed 3,295 persons, and paid £162,673 in wages, as compared with 3,071 persons and £146,669 in wages in 1912.

In addition to the 833 societies mentioned above, there were 73 industrial co-operative societies having farming and dairying departments. These departments employed 699 persons, paid £38,616 in wages during 1913, and had sales amounting in that year to £307,015.

The following Table shows, for England and Wales, Scotland and Ireland respectively, the sales of all the 906 distributing and productive societies and departments in 1913 :—

—	Agricultural Distributive Societies.	Agricultural Productive Societies and Departments.	Total. Amount.	Total. Percentage.
	£	£	£	
England and Wales ..	1 822,050	378,322	2,200,372	34·5
Scotland	417,742	285,988	703,730	11·0
Ireland	694,841	2,778,332	3,473,173	54·5
UNITED KINGDOM	2,934,633	3,442,642	6,377,275	100·0

The great predominance of the Irish societies in agricultural production is the outstanding feature of this Table, nearly 81 per cent. of the sales of productive societies and departments being in that country. In agricultural distribution the societies in England and Wales predominate with over 62 per cent. of the total sales.

Distribution.—The following Table shows for the years 1903–13 the sales of agricultural distributive societies in England and Wales, Scotland and Ireland respectively :—

Year.	England and Wales. No. of Societies.	England and Wales. Sales.	Scotland. No. of Societies.	Scotland. Sales.	Ireland. No. of Societies.	Ireland. Sales.
		£		£		£
1903 ..	48	87,970	2	42,760	136	393,542
1904 ..	65	146,197	2	44,850	155	372,080
1905 ..	82	214,292	5	46,610	150	371,273
1906 ..	111	387,775	8	51,511	161	420,223
1907 ..	121	572,735	12	80,338	163	484,771
1908 ..	131	751,445	19	99,530	157	469,556
1909 ..	145	885,683	31	227,141	160	491,034
1910 ..	165	1,036,515	43	291,838	168	521,193
1911 ..	217	1,325,547	55	335,470	159	525,580
1912 ..	228	1,623,805	69	367,273	153	641,239
1913 ..	242	1,822,050	73	417,742	150	694,841

In 1903 the sales in Ireland were about three times those of England and Wales and Scotland combined, but the growth in Great Britain has since been so rapid that in 1913 the sales there amounted to more than three times those in Ireland. Compared with 1912, the total sales in 1913 showed an increase in England and Wales of 12·2 per cent., in Scotland of 13·7 per cent., and in Ireland of 8·4 per cent.

Production.—The following Table gives the number of societies, with the amount of their sales and transfers, engaged in productive operations during the years 1903–1913 :—

Year.	Special Farming and Dairying Societies.		Farming and Dairying Departments of Wholesale and Retail Industrial Distributive Societies.		Total Agricultural Production by all Classes of Societies.	
	No. of Societies.	Sales.	No. of Societies.	Sales and Transfers.*	No. of Societies.	Sales and Transfers.*
		£		£		£
1903 ..	225	1,181,056	51	427,594	276	1,608,650
1904 ..	256	1,232,668	60	401,383	316	1,634,051
1905 ..	260	1,372,552	56	402,639	316	1,775,191
1906 ..	272	1,683,120	61	473,258	333	2,156,378
1907 ..	287	1,829,279	64	477,379	351	2,306,658
1908 ..	303	1,969,582	69	494,889	372	2,464,471
1909 ..	318	2,044,917	71	467,967	389	2,512,884
1910 ..	336	2,255,047	71	435,568	407	2,690,615
1911 ..	338	2,387,642	72	330,267	410	2,717,909
1912 ..	352	2,925,432	76	301,069	428	3,226,501
1913 ..	368	3,135,627	73	307,015	441	3,442,642

* The goods produced by the productive departments of Industrial Co-operative Societies are usually not sold direct, but are transferred to the *distributive departments.*

The total sales in 1913 were £3,442,642, an increase over those of 1912 of 6·7 per cent. The sales of the special farming and dairying societies increased 165·5 per cent., while the agricultural departments of industrial societies decreased 28·2 per cent. between 1903 and 1913.

Of the total production in 1913, 11 per cent. was in England and Wales, 8·3 per cent. in Scotland, and 80·7 per cent. in Ireland.

Profit-sharing.—The returns made show that of the 465 agricultural distributive societies 46, employing 262 persons and paying £14,538 in wages, paid bonuses to their employees amounting to £650, which was equal to 4·5 per cent. upon the wages of the participants.

Of the 368 agricultural productive societies 67, employing 432 persons and paying £19,225 in wages, paid bonuses to their employees amounting to a total of £1,042, or 5·4 per cent., upon the wages of the participants.

Of the 73 departments of industrial societies 13, employing 181 persons and paying wages amounting to £11,459, paid bonuses to their employees amounting to a total of £352, or about 3 per cent., upon wages; of this total £252, or about 72 per cent., was accounted for by the farming department of the Scottish Co-operative Wholesale Society.

Cattle and Pig Insurance Societies.—In addition to the co-operative societies engaged in agricultural production and distribution in 1913, there were in England and Wales 62 registered societies for the mutual insurance of the pigs and cattle belonging to their members. There was also one society in Guernsey.

The following Table shows the progress of these societies during the five years 1909–1913 :—

——	1909.	1910.	1911.	1912.	1913.
Number of Societies making Returns	57	58	58	61	63
Total membership ..	3,574	3,625	3,600	3,596	3,531
Receipts :—	£	£	£	£	£
Contributions	1,761	1,835	1,809	1,822	1,883
Other receipts	495	507	453	472	491
Total Receipts ..	2,256	2,342	2,262	2,294	2,374
Expenditure :—					
Benefits to Members ..	1,908	1,751	1,924	1,815	1,784
Working expenses ..	387	388	257	290	285
Total Expenditure ..	2,295	2,139	2,181	2,105	2,069
Total funds at end of year..	7,671	8,105	8,112	8,344	8,610

Registered pig and cattle societies, however, constituted only a small minority of the total number of such societies. There were about 1,200 unregistered pig and cattle clubs in England alone, of which some 400 were in Lincolnshire ; but complete information as to the financial operations of these societies is not available.

Co-operative Credit Associations.—At the end of 1913 there were at work in the United Kingdom 223 co-operative credit associations—17 urban and 206 rural—with an aggregate membership of 22,671, as compared with 154 associations and 10,509 members in 1903. The number of societies has thus increased by nearly 45 per cent., and the members more than doubled during the ten years.

Of the 223 associations 49, with 4,147 members, were in England ; one, with 353, was in Scotland ; and 173, with 18,171 members, were in Ireland.

All the Irish associations were rural, and the single Scottish association was urban. In England, 16 were urban and 33 rural.

The amount of loans advanced by these associations in 1913 was £72,308, and the amount repaid (including interest) was £81,307, compared with £33,753 advanced and £27,194 repaid in 1903. The total capital in 1913 was £168,700, and the amount owing by borrowers was £113,693.

The associations are usually managed by unpaid officials, and the working expenses are therefore small. The total working expenses (including interest on capital) of the whole of the 223 associations were only £7,586 in 1913. The aggregate net profit made by all the societies was £896.

The following Table gives details for the year 1913 of urban and rural societies in England and Wales, Scotland, and Ireland respectively :—

—	Urban.		Rural.		Totals.
	England and Wales.	Scotland.	England and Wales.	Ireland.	
Number of Societies	16	1	33	173	223
Membership ..	3,388	353	759	18,171	22,671
Capital :—	£	£	£	£	£
Shares	8,083	5,533	3	—	13,619
Loans	22,296	60,051	2,428	61,350	146,125
Reserves ..	1,229	2,490	350	4,887	8,956
Loans advanced ..	10,590	1,016	1,606	59,096	72,308
„ repaid (including interest) ..	11,975	4,899	1,740	62,693	81,307
Owing by borrowers	11,277	38,357	2,251	61,808	113,693
Working expenses (including interest paid on capital) ..	2,086	2,393	102	3,005	7,586
Net profit on year ..	228	140	41	487	896

Agricultural Credit in British Columbia.

VARIOUS provisions with regard to the granting of loans to agriculturists in British Columbia are made in the "Agricultural Act, 1915" of that province.

An "Agricultural Credit Commission" is set up with power to purchase, let, and deal in real and personal property and to grant loans on the security of mortgages for the following purposes :—

(1) The acquisition of land for agricultural purposes,

(2) Adaptation of agricultural land, or

(3) Any purpose calculated to increase the productiveness of agricultural land.

The loans are to be made on the basis of valuation by a "Department of Appraisal and Valuation," which is to be established by the Agricultural Credit Commission ; and the mortgages accepted as security must be first mortgages on surveyed agricultural land in the province.

In granting loans the Commission has to take the following points into consideration :—

(1) The value of the security, as fixed by the Appraisal Department,

(2) The ability of the borrower to make a living for himself and his family from the land after expenditure of the loan, and

(3) Whether the loan will be of economic benefit to the borrower.

The loans made are to vary in amount between £50 and £2,000 (approximately) in the case of individuals, but the latter amount may be exceeded in special instances in the case of associations ; no loan, however, is to exceed 60 per cent. of the appraised value of the security. The Commission may advance the loan to the borrower by instalments ; in no case will the advance made as part of a loan for improvements exceed the proportion of the work done to the entire work.

As regards the period of repayment, loans may be (1) long-dated, (2) short-dated (*i.e.*, from three to ten years), or (3) for a single season only (*i.e.*, repayable within 12 months). The rate of interest is to be fixed from time to time on the basis of not more than 1 per cent. above the rate actually paid by the Commission on funds raised for their own purposes. Long-dated loans are repayable within 36½, 30 or 20 years, [illegible] and interest are repayable half-yearly.

Additional loans may be granted up to the limit of 60 per cent. on the appraised value of the security.

The following provisions are made to meet cases of default: If the loan or interest is unpaid, or if the loan is not applied for the specified purpose, or carefully and economically expended, or not applied within a reasonable time, or if agreements are not observed, the Commission may refuse further instalments and recover advances made, without recourse to the Courts, by entering and taking possession of the security, which they may sell or lease, or place in the hands of a Receiver to manage and realise. The Commission, in transferring the lands acquired in this way, can give a good and valid title notwithstanding any encumbrance in favour of other persons.

OFFICIAL NOTICES AND CIRCULARS.

Preservation of Flocks and Herds and Maintenance of Meat Supply.

THE Board of Agriculture and Fisheries strongly urge all farmers **to raise as much stock as possible** during the war.

They make the following recommendations not only for the **National Welfare,** but because they believe them to be for the ultimate benefit of **British Agriculture.**

Their advice to you is—

Do not send breeding and immature stock to the **butcher** simply because prices are attractive **now.**

Do not market half-finished animals; it is wasteful of the country's resources and is against your own interest.

Do not kill calves,—rear them; it is well worth it.

Do not reduce your stock; when you cannot buy stores, buy calves.

Maintain your flocks and breed your sows; it will pay you to do so.

Crop and Stock Returns: Special Notice.

THE Board of Agriculture and Fisheries desire to draw the attention of occupiers of land to the special importance under present circumstances of the prompt collection of the annual Crop and Stock Returns. The information furnished by these returns will be particularly valuable in connection with the economy of the Nation's food supply during the war. The Board accordingly urge any occupier who has delayed filling up his schedule to do so immediately and to post it at once to the address shown on the forms. Farmers will serve the interests of the country by promptitude in this matter.

Fream Memorial Prize.

THE Board of Agriculture and Fisheries have awarded a Fream Memorial Prize, of the value of £7 4*s*. 7*d*., to Mr. John Wilson, New Road, Mauchline, Ayrshire, a student of the West of Scotland Agricultural College, Glasgow, who took first place in this year's examination for the National Diploma in Agriculture.

Sale of Army Mares for Breeding.

WITH a view of encouraging and assisting the breeding of light horses, the Board of Agriculture and Fisheries have been authorised by the War Office to arrange for the sale from time to time of Army mares which have been returned from abroad as no longer suitable for use with the Expeditionary Force, and which have been specially selected in France by the Board as of types suitable for breeding purposes.

These mares are kept under the care and observation of the Board for a month after their return from abroad, and are then sold by public auction on the express condition that they are not at any time to be exported out of the country. To secure observance of this condition the mares are branded with a distinctive mark of diamond shape (<>).

The mares are not sold unless they have passed the mallein test for glanders to the satisfaction of the Board's Veterinary Officers, but no guarantee is given as to their age, soundness or otherwise. The mares can be examined prior to disposal at the places of sales by veterinary surgeons on behalf of intending purchasers.

Mares to be sold can be seen at the Cattle Testing Station, Pirbright, Surrey (Woking Station 5 miles, Brookwood Station 3 miles) by arrangement with the Inspector-in-Charge.

The fourth consignment of these mares, 78 in number, was sold by order of the Board as follows :—

12 on 2nd June at Carlisle, by Messrs. R. Harrison & Son.
9 on 4th June at Exeter, by Messrs. J. A. Collings & Sons.
12 on 4th June at Chippenham, by Messrs. Tilley, Parry & Culverwell.
9 on 4th June at Lichfield, by Messrs. Winterton & Sons.
9 on 5th June at Shrewsbury, by Messrs. Hall, Wateridge & Owen.
9 on 5th June at Norwich, by Messrs. Spelman.
9 on 5th June at Berwick-on-Tweed, by Mr. A. L. Miller.
9 on 8th June at Haverfordwest, Pembroke, by Messrs. Evans & Roach.

It is hoped to arrange for further sales in various parts of the country during the next few months.

The Board take this opportunity of drawing the attention of owners of mares to the fact that all Premium Stallions subsidised by the Board are travelling during the present season at the low service fee of £1.

American Gooseberry Mildew (Fruit) Order of 1915.

THE American Gooseberry Mildew (Fruit) Order of 1915 of the Board of Agriculture and Fisheries, which applies to England and Wales and came into force on 24th May 1915, contains the following (among other) provisions :—

*Prohibition of Sale or Consignment of Diseased Gooseberries.**—The sale or exposure for sale or consignment for sale of diseased gooseberries is hereby

* Disease in this and the following two Orders refer exclusively to

prohibited, and any person who sells or exposes for sale or consigns for sale diseased gooseberries shall be liable on conviction to a penalty not exceeding ten pounds, unless he proves that he did not know that the gooseberries were diseased.

Regulation of Importation of Gooseberries.—(1) The landing in England or Wales of gooseberries brought from any place outside Great Britain (except the Channel Islands) is prohibited except where there is attached to the package in which the fruit is imported a label bearing the words " Imported gooseberries," and stating the country and district in which the fruit was produced, and either the name of the consignor, or a distinctive name or mark.

(2) The label required by this Article shall not be erased or obliterated or detached from the package so long as any of the imported gooseberries remain therein.

Labelling of Gooseberries Consigned for Sale.—(1) The consignment for sale of gooseberries is prohibited except where there is attached to the package a label bearing the name and address of the consignor or a distinctive name or mark.

(2) The label required by this Article shall not be erased or obliterated or detached from the package so long as any of the consigned gooseberries remain therein.

Information to be given as to Diseased Gooseberries.—Every person who has or has had in his possession diseased gooseberries, and every person who, as auctioneer, salesman or otherwise, has sold or offered for sale diseased gooseberries shall, if so required in writing by the Board or the Local Authority or an Inspector of the Board or Local Authority, give the Board or the Local Authority or the Inspector, as the case may be, all such information as he possesses as to the premises on which the gooseberries were grown, and as to the name and address of the person (if any) by whom the gooseberries were sold or consigned to him, or in the case of imported gooseberries as to the country and district in which the gooseberries were produced, and the consignor by whom and the consignee to whom the fruit was consigned to England or Wales ; provided that any information given under this Article shall not be available as evidence against the person giving the same in any proceedings under this Order except in respect of an alleged failure to comply with this Article.

Destruction of Diseased Gooseberries.—An Inspector of the Board or of the Local Authority appointed for the purpose may by notice served on any person having in his possession or under his charge diseased gooseberries require him to destroy forthwith all such diseased gooseberries by fire or other effectual means, and for this purpose require him to remove the gooseberries from the package in which they are contained.

Cleansing of Packages containing Diseased Gooseberries.—A package which has contained diseased gooseberries shall, after the removal of all gooseberries therefrom, and before the package is used for packing gooseberries or any other description of fruit, be thoroughly cleansed by washing, or other suitable method, by the owner or person in charge of the package.

Powers of Inspectors to Enforce Cleansing of Packages.—An Inspector of the Board or of the Local Authority may by notice served on any person who has in his possession or under his charge a package which contains or has contained any imported gooseberries or any diseased

gooseberries, whether imported or not, require such person to cleanse the package thoroughly to his satisfaction by washing or other suitable method, or if such person so prefer, to destroy the same forthwith in the presence of the Inspector, and for the purpose of such cleansing or destruction to remove from the package any fruit therein.

Power to Prohibit Removal of Packages containing Diseased Gooseberries.—An Inspector of the Board or of the Local Authority may, by notice served on any person who has in his possession or under his charge a package which contains any diseased gooseberries, prohibit the removal of the package from the premises where it is, until the diseased gooseberries are removed therefrom.

Powers of Entry.—Any Inspector or other officer appointed in that behalf by the Local Authority, or by the Board, may upon production if so required of his appointment or authority enter any premises on which he has reason to believe that there are any imported or diseased gooseberries or is any package which contains or has contained any such gooseberries, and examine the gooseberries and packages on such premises.

Offences.—Every person shall be liable on conviction to a penalty not exceeding ten pounds, who—

(1) consigns gooseberries for sale in contravention of this Order ; or

(2) in contravention of this Order erases or obliterates or detaches a label from a package ; or

(3) refuses or fails to give any information required under this Order, or gives false information ; or

(4) fails to cleanse any package in accordance with this Order ; or

(5) when served with a notice under this Order, fails to cleanse or destroy in the prescribed manner the package or fruit to which the notice relates, or to remove the fruit from the package ; or

(6) removes any package in contravention of a notice served under this Order ; or

(7) wilfully obstructs or impedes any Inspector or other officer in the course of his duties under this Order.

Revocation of Order.—(1) The American Gooseberry Mildew (Fruit) Order of 1914 is hereby revoked ; provided that such revocation shall not—

(i.) affect the previous operation of that Order or anything duly done or suffered under that Order ; or

(ii.) affect any right, privilege, obligation, or liability acquired, accrued, or incurred under that Order ; or

(iii.) affect any penalty incurred in respect of any offence committed against that Order ; or

(iv.) affect any investigation, legal proceeding, or remedy in respect of any such right, privilege, obligation, liability, or penalty as aforesaid ;

and any such investigation, legal proceeding, or remedy may be instituted, continued, or enforced, and any such penalty may be imposed, as if this Order had not been made.

(2) Every notice served under the Order hereby revoked shall have effect as if it were a notice under this Order.

Execution of the Order.—Each Local Authority shall carry into effect this Order within their District, and shall appoint such Inspectors or other officers for that purpose as may be necessary.

THE American Gooseberry Mildew (Infected Areas) Order of 1915 of the Board of Agriculture and Fisheries contains the following (among other) provisions :—

American Gooseberry Mildew (Infected Areas) Order of 1915.

1. *Application of Order.*—The provisions of this Order, which refer to an Infected Area, shall apply to any area which is declared by Order of the Board to be infected with "disease" as defined by this Order, and to be an Infected Area for the purposes of this Order.

2. *Notification of Disease.*—The occupier of any premises in an Infected Area on which disease exists or appears to exist shall forthwith notify the fact by post or otherwise to the Board, or to the person authorised by the Board to receive such reports. Where this Article applies Article 3 (*Notification of Disease*) of the American Gooseberry Mildew Order of 1911 shall not apply.

3. *Destruction of Diseased Fruit.*—The occupier of any premises in an Infected Area shall forthwith destroy on the premises by fire or other suitable method all diseased fruit of the gooseberry bushes on the premises.

4. *Removal of Visible Traces of Disease.*—All visible traces of disease on any part of a gooseberry bush within an Infected Area shall in each year be cut off and forthwith destroyed by fire by the occupier of the premises on which the bush is growing on or before the thirtieth day of September.

5. *Removal of Bushes.*—(1) No gooseberry bush or part of a gooseberry bush (other than fruit which is free from disease) shall be moved or permitted by the owner thereof to be moved out of an Infected Area except under the authority, and in accordance with the conditions (if any), of a licence granted by an Inspector of the Board.

(2) Where any bush has been moved in contravention of this Article an Inspector of the Board may, by notice served by post or otherwise on the person in whose possession or under whose charge the bush is, require the movement forthwith of the bush back to the premises from which it was lifted or taken for the purpose of the movement out of the Infected Area, or its destruction forthwith by fire if the owner so prefer.

6. *Partial Exemption from General Order.*—No part of an Infected Area shall be declared to be "infected premises" under the American Gooseberry Mildew Order of 1911, and any premises included in an Infected Area shall cease to be "infected premises."

8. *Offences.*—Every person shall be liable on conviction to a penalty not exceeding ten pounds, who—

(1) fails to give notification of disease as required by Article 2 ; or

(2) fails to destroy any diseased fruit as required by Article 3 ; or

(3) fails to cut off and destroy all traces of disease as required by Article 4 ; or

(4) moves or permits to be moved any bush in contravention of Article 5, or fails to comply with any notice served under that Article.

THE American Gooseberry Mildew (Kent) Order of 1915 of the Board of Agriculture and Fisheries, which will come into force on 1st July, 1915, contains the following (among other) provisions :—

American Gooseberry Mildew (Kent) Order of 1915.

Restriction on Movement of Bushes in Scheduled District.—(1) No gooseberry bush shall be moved, or be permitted by the occupier of the premises to be moved, from any premises in the District

described in the Schedule* to this Order (hereinafter referred to as "the Scheduled District"), to any other premises, whether within the Scheduled District or not, unless such movement is authorized by a licence signed by an Inspector of the Board; and where any premises in the same occupation are divided by a highway the several parts shall for the purposes of this Order be treated as separate premises.

(2) A licence may contain such conditions as the Inspector may think fit for the purpose of preventing the spread of disease.

Exceptions from Facilities for Movement.—No gooseberry bush shall be moved, or be permitted by the occupier of the premises to be moved, from any premises in the Scheduled District which is diseased or suspected of being diseased, or which has not been pruned in such manner as may have been required by an Inspector of the Board, whether the movement is authorized by a licence under this Order or not.

Production of Licences and Labels.—Any persons in charge of gooseberry bushes being moved in the Scheduled District, if so required by an Inspector of the Board or a police officer, shall produce and show to the Inspector or officer the licence or label (if any) accompanying the bushes in compliance with the conditions of a licence granted under this Order, and shall allow the Inspector or officer to make a copy of or extract from the licence or label, and shall give his name and address to the Inspector or officer.

Powers of Inspection of Bushes.—Any Inspector of the Board may upon production if so required of his appointment inspect any gooseberry bushes which are being moved in the Scheduled District, or have been moved from any premises in the Scheduled District.

Notification of Order.—This Order shall be published by the Local Authority of each District comprised in the Scheduled District by advertisement in a newspaper circulating in that District, or in such other manner as the Local Authority consider best fitted to insure publicity for the same.

Offences.—Every person shall be liable on conviction to a penalty not exceeding ten pounds, who—

(1) moves any bush, or permits any bush to be moved, in contravention of this Order; or

(2) fails to comply with the conditions inserted in a licence under this Order; or

(3) refuses, or without reasonable excuse fails, to produce or show or permit to be copied, a licence or label in accordance with the requirements of this Order, or fails to give his true name and address when required to give the same under this Order; or

(4) wilfully obstructs or impedes any Inspector or other officer in the course of his duties under this Order.

Revocation of Orders.—The American Gooseberry Mildew (Maidstone District) Order of 1910, the American Gooseberry Mildew (Sandwich District) Order of 1910, and the American Gooseberry Mildew (Swanley District) Order of 1910 are hereby revoked as from the commencement of this Order; provided that such revocation shall not—

(i.) affect the previous operation of those Orders or anything duly done or suffered under those Orders; or

(ii.) affect any right, privilege, obligation, or liability acquired, accrued, or incurred under those Orders; or

* The scheduled district for the purposes of the Order is the administrative county of Kent and the city of Canterbury.

(*iii.*) affect any penalty incurred in respect of any offence committed against those Orders; or

(iv.) affect any investigation, legal proceeding, or remedy in respect of any such right, privilege, obligation, liability, or penalty as aforesaid;

and any such investigation, legal proceeding, or remedy may be instituted, continued, or enforced, and any such penalty may be imposed, as if this Order had not been made.

Report on Allotments, 1914.

PART II. (Allotments and Miscellaneous) of the Annual Report of the proceedings of the Board during 1914 under the Small Holdings and Allotments Acts, the Universities and College Estates Acts, the Glebe Lands Act, the Improvement of Land Acts, the Settled Land Acts, the Agricultural Holdings Acts, and certain other Acts has been published [Cd. 7892] and may be obtained from Messrs. Wyman & Sons, or through any bookseller, price 8½*d*.

Proceedings under the Tithe, &c., Acts for 1914.

THE Annual Report for 1914 of the proceedings of the Board under the Tithe, Copyhold, Inclosure, Commons, Land Drainage and other Acts has been issued [Cd. 7916] and may be obtained from Messrs. Wyman & Sons, Ltd., or through any bookseller, price 2d.

MISCELLANEOUS NOTES.

Scottish Seed Testing Station.*

IN compliance with a generally expressed desire on the part of farmers and representative agricultural bodies in Scotland, the Board of Agriculture for Scotland in the month of February, 1914, established a seed testing station at Edinburgh. Although the condition of the seed trade in Scotland might be considered in many respects satisfactory, it was thought that a seed testing station would be of great advantage, inasmuch as it would provide an authoritative method of testing seeds which would be accepted both by farmers and by seedsmen. Prior to the establishment of the station in Edinburgh seeds had to be tested either by private analysts in Scotland or (as was done to a large extent) at Continental stations. The analyses obtained from the Continent, although considered quite trustworthy, were reported in such a way as to be unsatisfactory for the grower's purpose, and the farmer could not make a comparison between the guarantee given to him by seedsmen whose seeds had been tested on the Continent and the result of a test made in this country. The farmers felt, therefore, that they were at a disadvantage, whilst the seedsmen admitted that the guarantees which they gave were not of much practical use to the farmers.

The special functions of the station may be defined as follows:—

(1) To provide a cheap method of testing seeds available both to seedsmen and to farmers, and to test tree seeds for landowners and nurserymen.

---

* Third Report of the Board of Agriculture for Scotland [Cd. 7899]. Price 10½*d*.

(2) To obtain information for the Board of Agriculture for Scotland and for the country as to the quantities of inferior seeds which are being sold.

The system of testing seeds adopted at the station, after very careful investigation of the various systems now in vogue, may be described briefly as follows :—

Purity Tests.—In testing for purity, only foreign seeds and foreign matter, such as sand, etc., are treated as impurities. Immature seeds and seeds without a kernel are retained as pure seeds.

Germination Tests.—All seeds of the species to which the sample purports to belong may be included without reference to their condition of maturity in the germination tests.

Tests made by these methods emphasise differences in grades of quality much more definitely than those made by Continental stations and private analysts, whose practice is generally to treat as impurities all immature seeds, and to include in the germination test only mature seeds. The methods practised at the Scottish Board's station should therefore be preferred by agriculturists who buy their seeds on a guarantee of quality. It may be added that the methods described above are identical with those used in the Seed Testing Station of the Department of Agriculture and Technical Instruction for Ireland.

The number of samples tested at the Station between the date of its opening and 31st December was 364. These fall into the following classes :—

(*a*)	Samples tested for	Farmers and other Growers ..	74
(*b*)	,, ,,	Non-trading (Farmers') Societies	56
(*c*)	,, ,,	Educational Institutions, etc. ..	38
(*d*)	,, ,,	Co-operative Trading Societies ..	7
(*e*)	,, ,,	Merchants	150
(*f*)	,, ,,	Information of Station ..	39

The subjoined table indicates the groups of seeds tested and the nature of the tests :—

Description of Seeds.	For Purity only.	For Germination only.	For Complete Test.	Total.
Grasses*	6	21	163	190
Leguminous Plants ..	1	22	98	121
Forage Plants	—	3	12	15
Forest Tree Seeds	—	9	19	28
Cereals	—	1	4	5
Total	7	56	296	359

* Two samples of grasses and three others of a miscellaneous character were forwarded for identification only.

Samples of seeds received since the commencement of the present season have been, in general, of high quality. The following table indicates the average of the results of tests of the common species of grasses and clovers. These averages are not of selected samples but of all the samples submitted for analysis from October to December, 1914 :—

	Average Percentage of Purity.	Average Percentage of Germination.
Perennial Rye-grass ..	98·3	90
Italian Rye-grass ..	99·2	88·8
Cocksfoot	98·1	76·5
Meadow Fescue	98·3	94
Timothy	97·5	92
Alsike	97·2	91 + 6 hard seeds
Red Clover	98·4	92 + 5 ,,
White Clover	97·5	89 + 6 ,,
Trefoil	99·2	96 + 3 ,,

Fees.—The fee charged for reports on the purity and germination of samples is 2*s*. per sample when furnished to merchants and others engaged in the sale of seeds, and 3*d*. per sample when furnished to others (farmers, foresters, gardeners, etc.).

Notes on Agriculture Abroad.

A German Karakul Sheep Breeding Centre.—The Karakul sheep breeding centre at Naunhof, near Leipzig, is described in the *Deut. Landw. Presse*, 21st April, 1915. It was founded about ten years ago by the purchase of pure bred ewes partly direct from Bokhara and partly from Hagenbeck's collection; and the owner, who at the time possessed some dye works and handled large quantities of skins, was led to establish the centre from a consideration of the profit to be obtained from the successful breeding of these sheep. The animals became acclimatised in spite of stall feeding and relatively little pasturage, and there have been hardly any deaths from disease. The animals may only be pastured in dry weather, and are found to take cover during rain. The herd at present comprises 30 pure bred ewes. A herd book is kept and the animals are judged when lambs by the curl of the hair, this being of the first importance. The rams have been widely distributed, in particular to South West Africa.

Live Stock at the Panama-Pacific International Exhibition, 1915.—The Panama-Pacific Internatioual Exhibition, which is now being held at San Francisco, includes a section for live stock, and awards will be made for all classes of animals. The exhibition dates for the various classes are as follows:—Horses, September 30th to October 13th; beef and dairy cattle, October 18th to November 1st; sheep and goats, November 3rd to 15th; fat cattle, sheep and swine, November 11th to 14th; poultry, November 18th to 28th. A total sum of £91,780 is available for prizes and other expenditure connected with the live stock section, of which £20,900 has been contributed by 45 breed societies. Most of the well-known British breeds will be recognised by the authorities.

Applications for full particulars should be addressed to Chief D. O. Lively, Department of Live Stock, Panama-Pacific International Exposition, San Francisco, California.

Importation of Live Stock and Fodder into Bermuda.—Regulations have recently been made in the Colony of Bermuda whereby, under the Animal Diseases Act of 1914, horses, asses, mules, cattle, sheep, goats, and pigs (as well as fodder accompanying the animals), cannot

be landed without a written permit issued by the Government Veterinary Officer. All animals in the Colony are subject to inspection and to quarantine. The importation of bulls, dairy cows and pigs, from the United States of America is prohibited. It is indicated that these regulations will remain in force until the end of the year 1916.

Importation of Animals into Canada.—The Canadian Department of Agriculture has resumed the issue of permits for the importation into Canada of cattle, sheep and swine from any port of the United Kingdom.

Notes on Crop Prospects Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for May, 1915, issued by the International Institute of Agriculture, gives the condition of winter cereals on 1st May as follows (100 being taken to represent the prospect of an average crop) :—*Wheat*—Denmark 96, Scotland 100, Ireland 101, Switzerland 98, Canada 112, Japan 106, Lower Egypt 105, Upper Egypt 102, Tunis 130. *Rye*—Denmark 99, Ireland 101, Switzerland 98. *Barley*—Denmark 100, Scotland 105, Ireland 101, Switzerland 99, Japan 100, Lower Egypt 99, Upper Egypt 104, Tunis 125. *Oats*—Denmark 100, Scotland 105, Ireland 101, Switzerland 99, Tunis 110.

Australia.—The amended estimate of the wheat yield in 1914-15 places the production at 3,114,000 qr., against 12,915,000 qr. in 1913-14, the decrease amounting to 75·9 per cent.

France.—According to a statement giving the results of an enquiry into the agricultural situation on 1st May, as compared with that on 1st May, 1914, the area sown with wheat in the whole of France, including the invaded territories, is over 14,000,000 acres, or about 2,000,000 acres less than in 1914, with rye about 2,500,000 acres compared with nearly 3,000,000 acres, with barley about 1,700,000 acres against over 1,800,000 acres, and with oats nearly 8,500,000 acres as compared with about 10,000,000 acres in 1914. The condition of wheat was 72 as compared with 71 in 1914, of rye 70 against 74, of barley 74 against 71, and of oats 73 against 70 in 1914. (100 = very good, 80 = good, 60 = fairly good). (*The London Grain, Seed and Oil Reporter*, 28th May.)

Italy.—A preliminary official estimate puts the wheat crop at 25,700,000 qr., compared with 21,200,000 qr. last year. (*Broomhall's Corn Trade News*, 13th May.)

Russia.—According to a report of the Central Statistical Committee, the condition of both spring and winter crops on 1st April was, on the whole, quite favourable. Only in two out of thirty-two governments was the state of the winter crops, and in one out of seven that of the spring sowings not quite satisfactory. In all other governments from which data is available the condition is average or above average. (*The London Grain, Seed and Oil Reporter*, 25th May.)

United States.—The Crop Reporting Board of the Department of Agriculture, in reporting as to crop conditions on the 1st June, states that the production of winter wheat is estimated at 676,000,000 bush. as compared with a yield of 684,990,000 bush. last year. The area sown with spring wheat was 19,248,000 acres, and the yield is estimated at 274,000,000 bush. against 206,027,000 bush. last year. The area

under oats is 40,193,000 acres, and the total production is estimated at 1,288,000,000 bush. against 1,141,000,000 bush. last year; whilst the area under barley is 7,393,000 acres, and the total production is estimated at 197,000,000 bush. against 194,953,000 bush. last year. (*The London Grain, Seed and Oil Reporter*, 8th June.)

Argentina.—According to a return issued by the Argentine Ministry of Agriculture on the 8th June, the total production of wheat is estimated at 4,585,000 tons as compared with 3,100,000 tons last year; oats, 831,000 tons against 740,000 tons; and linseed, 1,126,000 tons against 995,000 tons last year. (*The London Grain, Seed and Oil Reporter*, 8th June.)

Fruit.—*Holland.*—His Britannic Majesty's Consul-General at Rotterdam reported (12th May) that the prospects for all sorts of small fruit were generally very favourable, although blossoming was somewhat late on account of the wet and cold weather during the first three months of the year. In the provinces of North Holland and North Brabant some injury had been done by night frosts, whilst in the Westland district, the Hoeksche Waard and in Zealand insects have done some damage. *Early Cherries.*—In Gelderland, north of the Rhine, in the west of Utrecht and about Herwynen and Yzendoorn conditions were good, in Limburg excellent, and in all other districts very good. *Late Cherries* were excellent in the Hoeksche Waard and in Limburg, good to very good in South Beveland, and very good in eastern North Brabant. *Red and White Currants* were good in the Westland district, in Gelderland north of the Rhine, in Overijssel and in the south-east of Utrecht, and very good elsewhere. *Black Currants* were good in the Lower Betuwe, the district of Maas and Waal, around Utrecht and in the south-east of that province and moderate to very good in other parts of the country, while the reports from Limburg were excellent. *Gooseberries* were moderate in Utrecht, good in the Lower Betuwe, good to very good in West Friesland and in the Beemster, very good in Zealand and excellent in Limburg. *Raspberries* were good to very good in all parts of the country.

Live Stock in Japan.—The numbers of live stock at the end of 1913 were as follows:—Cattle 1,388,708, against 1,399,498 at the end of 1912, or a decrease of 0·8 per cent.; horses 1,533,829, against 1,581,743, or a decrease of 3·0 per cent.; sheep 2,946, against 3,308, or a decrease of 10·9 per cent.; pigs 309,995, against 308,970, or an increase of 0·3 per cent. (*Bulletin of Agricultural and Commercial Statistics*, May, 1915.)

Agricultural Labour in England and Wales during May.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st June, the supply of labour was reported to be deficient in all districts, and wages for the most part rose. The conditions in various districts were as follows:—

Northumberland, Durham, Cumberland, and Westmorland.—In many places there was a great scarcity of labour, and in Northumberland wages were increased by 2*s.* to 3*s.* per week, while 15 per cent. to 20 per cent. increase was reported from Cumberland and Westmorland. A great lack of servants was disclosed as a result of the Whitsuntide hirings.

Lancashire and Cheshire.—The supply of labour was deficient, and wages rose.

Yorkshire.—There was a general deficiency, particularly among horsemen, and increases in wages were frequently reported.

Shropshire and Stafford.—Labour was scarce throughout the district.

Derby, Nottingham, Leicester, and Rutland.—The supply was deficient in all districts and wages were tending still higher. May hirings in East Notts showed a considerable increase.

Lincoln and Norfolk.—Labour was short, but the deficiency appeared to be less felt in Norfolk where it was mostly "just sufficient." Wages at the May hirings showed a rise.

Suffolk, Cambridge, and Huntingdon.—There was a deficiency in the supply of labour generally.

Bedford, Northampton, and Warwick.—Labour was deficient and casual labour difficult to obtain, or inefficient. Rises of 1*s.* to 3*s.* per week in wages were reported from many districts.

Buckingham, Oxford, and Berkshire.—Labour was generally deficient, and more would be required for singling and for getting in the hay.

Worcester, Hereford, and Gloucester.—The supply of labour was very scarce.

Cornwall, Devon, and Somerset.—The supply of labour was generally deficient.

Dorset, Wiltshire, and Hampshire.—The supply of labour was very deficient.

Surrey, Kent, and Sussex.—Labour generally was deficient, and it was anticipated that with the heavier work the shortage would soon be seriously felt. In one or two districts of Kent there was some slight increase in wages. Farmers, however, were making the best of the new conditions.

Essex, Hertford, and Middlesex.—There was a shortage of labour practically everywhere, and during the month there was a rise in wages of 1*s.* per week in western Essex.

North Wales.—Labour was reported as deficient through the district, except in Anglesey, where, however, casual labourers were scarce, and in Carnarvon, where it is anticipated that there would be a shortage for the harvest. There was a rise of wages in these two counties and in Denbigh from 1*s.* to 3*s.* per week.

Mid-Wales.—In some districts labour was scarce, but, generally, the farmers were adapting themselves to the shortage. In Radnor, the wages of single men, living in, rose 10 per cent.

South Wales.—There was a great scarcity of labour in almost every district in this division. Higher wages were asked in south-eastern Glamorgan.

Agricultural Conditions in England and Wales on 1st June.

THE Crop Reporters of the Board, in commenting on agricultural conditions in England and Wales on the 1st June, state that wheat is generally in a healthy and vigorous condition, and has improved during the month, though on some of the heavy lands it is rather discoloured. Barley and oats are somewhat backward, the cold nights and dry weather having retarded their growth. All crops would be benefited by warmer weather and more rain. The area under barley is estimated to be about 6 per cent. less than in 1914, but that of oats is about 5 per cent. larger. Beans and peas are generally promising.

Early potatoes have been affected by the frosts in some districts, but are mostly healthy. The planting of the main crop is nearly completed, but very little is yet showing above ground. The area planted is estimated to be about the same as in last year.

Nearly all the mangolds have been got in, but germination is slow. Where it is up, the plant is looking healthy. Turnip sowing is generally backward, having been delayed by shortage of labour and the dry weather.

Hops in Kent, though backward, are generally strong and healthy, and the growth is now progressing. There is some fly but not much as yet. In the western hop counties the condition of the crop is good, but the growth has been checked by the cold winds and frosts of the past month. The area under the crop is estimated at 5 per cent. less than that of last year.

The prospects for the fruit crops are good at the date of the reports. Strawberries, raspberries, gooseberries and currants promise to be over average crops, while apples, pears and cherries are also expected to yield good crops. Plums are the least satisfactory, but may amount to an average.

Crops of both "seeds" hay and meadow hay are expected to be below the average for the country as a whole, with slightly better prospects for the former. Wales, however, anticipates an over average yield for both crops, but in England the yield is expected to be from 2 to 5 per cent. below the normal. The prospects of the crops have been affected by low temperature and lack of rain. The area reserved for hay from "seeds" is expected to be slightly less than in 1914, but that of meadow hay is estimated to be about the same.

The pastures generally need rain, but stock on the whole are doing well.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st June, 1915, certain diseases of animals existed in the countries specified :—

Denmark (month of April).

Anthrax, Foot-and-Mouth Disease (1,132 outbreaks), Glanders and Farcy, Swine Erysipelas, Swine Fever.

France (for the period 2nd—15th May).

Foot-and-Mouth Disease, Glanders and Farcy.

Holland (month of April).

Anthrax, Foot-and-Mouth Disease (64 outbreaks), Foot-rot, Glanders, Swine Erysipelas.

Italy (for the period 10th—16th May).

Anthrax, Blackleg, Foot-and-Mouth Disease (97 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosis.

Norway (month of April).

Anthrax, Blackleg.

Rumania (for the period 5th—13th April).

Foot-and-Mouth Disease, Glanders and Farcy, Rabies, Sheep-pox, Swine Fever.

Russia (month of December).

Anthrax, Foot-and-Mouth Disease (43,787 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

***Spain** (month of March).*

Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

***Sweden** (month of April).*

Anthrax, Blackleg, Foot-and-Mouth Disease, (16 outbreaks), Swine Fever.

***Switzerland** (for the period 17th—23rd May).*

Anthrax, Blackleg, Foot-and-Mouth Disease (7 " étables " entailing 91 animals, of which 6 " étables " were declared infected during the period), Swine Fever.

No further returns have been received in respect of the following countries:—Austria, Belgium, Bulgaria, Germany, Hungary, Montenegro, Serbia.

The Weather in England during May.

District.	Temperature.		Rainfall.				Bright Sunshine.	
	Daily Mean.	Diff. from Average.	Amount.		Diff. from Average.	No. of Days with Rain.	Daily Mean	Diff. from Average.
	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours.
Week ending May 8th:								
England, N.E. ...	47·9	+1·1	0·18	4	— 6	2	6·7	+0·9
England, E.	51·8	+3·4	0·11	3	— 7	2	7·4	+1·2
Midland Counties ...	51·6	+3·3	0·22	5	— 6	2	5·9	+0·3
England, S.E.... ...	54·1	+4·5	0·11	3	— 7	1	7·0	+0·7
England, N.W. ...	49·4	+1·4	0·23	6	— 7	2	6·9	+1·2
England, S.W. ...	53·5	+4·5	0.39	10	— 4	2	5·9	—0·4
English Channel ...	53·8	+3·1	0·44	11	0	4	4·1	—3·5
Week ending May 15th:								
England, N.E.... ...	44·5	—3·2	0·75	19	+ 8	3	6·7	+0·4
England, E.	47·0	—2·5	1·42	36	+26	4	7·3	+0·8
Midland Counties ...	46·7	—2·7	1·10	28	+18	4	6·6	+0·6
England, S.E.... ...	49·7	—1·1	1·71	44	+35	3	7·1	+0·4
England, N.W. ...	45·3	—3·8	0·56	14	+ 2	2	6·7	+0·4
England, S.W. ...	48·9	—1·3	1·42	36	+24	3	6·5	—0·2
English Channel ...	51·0	—0·8	0·75	19	+10	3	6·1	—2·1
Week ending May 22nd:								
England, N.E. ...	50·0	+1·1	0·13	3	— 7	2	4·9	—1·6
England, E.	51·8	+0·9	0·37	10	— 1	3	3·8	—2·8
Midland Counties ...	52·1	+1·3	0·71	18	+ 6	3	5·0	—1.1
England, S.E.... ...	53·2	+0·9	1.45	37	+27	4	3·9	2·9
England, N.W. ...	52·0	+1·5	0·46	12	— 1	3	6·4	—0·2
England S.W. ...	53·0	+1·3	0·80	20	+ 8	4	3·3	—3·6
English Channel ...	54·0	+1·0	0·30	8	— 2	3	4·6	—3·5
Week ending May 29th:								
England, N.E. ...	50·9	+0·2	0·31	8	— 2	2	8·9	+2·5
England, E.	53·8	+1·1	0·02	1	—10	1	10·2	+3·3
Midland Counties ...	54·2	+1·6	0·04	1	—12	1	10·5	+4·5
England, S.E.... ...	56·3	+2·3	0·00	0	—11	0	11·4	+4·5
England, N.W. ...	53·9	+1·8	0·10	2	—11	1	11·9	+5·2
England, S.W. ...	57·3	+4·2	0·05	1	—12	0	12·1	+5·3
English Channe ...	57·3	+3·0	0·01	0	—12	0	12·0	+4·0

* 1 inch = 25·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	MAY.		FIVE MONTHS ENDED MAY.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	59	77	326	392
Animals attacked	66	81	363	418
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	11
Animals attacked	—	—	—	74
Glanders (including Farcy):—				
Outbreaks	2	9	13	42
Animals attacked	2	10	18	89
Parasitic Mange:—				
Outbreaks	137	161	*326	1,257
Animals attacked	205	257	*734	2,247
Sheep-Scab:—				
Outbreaks	11	5	154	144
Swine Fever:—				
Outbreaks	566	605	1,841	1,770
Swine Slaughtered as diseased or exposed to infection ...	2,793	6,559	8,339	17,926

* Figures for two months only, the Parasitic Mange Order of 1911 having been suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	MAY.		FIVE MONTHS ENDED MAY.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	—	1	1	1
Animals attacked	—	1	1	1
Foot-and-Mouth Disease:—				
Outbreaks	—	8	—	74
Animals attacked	—	119	—	946
Glanders (including Farcy):—				
Outbreaks		—	1	—
Animals attacked	—	—	3	—
Parasitic Mange:—				
Outbreaks	7	6	23	45
Sheep-Scab:—				
Outbreaks	27	24	240	335
Swine Fever:—				
Outbreaks	26	16	121	104
Swine Slaughtered as diseased or exposed to infection ...	172	122	739	517

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in May and April, 1915.

(*Compiled from Reports received from the Board's Market Reporters.*)

Description.	May. First Quality.	May. Second Quality.	April. First Quality.	April. Second Quality.
FAT STOCK :—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle :—	s. d.	s. d.	s. d.	s. d.
Polled Scots	12 10	11 9	11 3	10 6
Herefords	12 2	10 11	11 3	10 2
Shorthorns	12 3	11 4	11 2	10 4
Devons	12 3	11 5	11 4	10 6
Welsh Runts	—	—	10 11	10 2
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	11	10	10¾	9¾
Sheep :—				
Downs	11¾	10¾	11¾	10¾
Longwools	11	10	10¾	9¾
Cheviots	12¼	11¼	12½	11¼
Blackfaced	12	11	12	11¼
Welsh	12	10¾	12	11
Cross-breds	11¾	10¾	12	10¾
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs :—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	9 4	8 9	9 5	8 11
Porkers	9 9	9 2	9 10	9 3
LEAN STOCK :—	per head.	per head.	per head.	per head.
Milking Cows :—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	25 6	20 17	24 5	20 1
,, —Calvers ...	23 0	19 17	23 3	19 4
Other Breeds—In Milk ...	21 10	18 15	22 3	18 4
,, —Calvers ...	17 15	16 17	19 9	16 12
Calves for Rearing	3 0	2 8	2 16	2 3
Store Cattle :—				
Shorthorns—Yearlings ...	13 10	11 13	13 2	11 2
,, —Two-year-olds...	18 4	16 3	17 7	15 4
,, —Three-year-olds	22 7	19 9	22 0	18 15
Herefords —Two-year-olds...	21 3	19 1	19 15	18 1
Devons— ,,	20 0	17 4	18 14	17 2
Welsh Runts— ,,	17 1	16 10	17 3	16 5
Store Sheep :—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	56 8	50 0	58 2	50 9
Store Pigs :—				
8 to 12 weeks old	24 10	19 3	24 1	18 6
12 to 16 weeks old	41 2	30 10	39 8	30 6

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in May, 1915.

(*Compiled from Reports received from the Board's Market Reporters.*)

Description.	Quality.	Birmingham.	Leeds.	Liverpool.	London.	Manchester.
		per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.
BEEF:—						
English	1st	83 6	83 6	—	89 0	85 0
	2nd	78 6	81 0	—	85 0	81 0
Cow and Bull	1st	74 6	77 6	77 0	76 6	78 0
	2nd	70 0	71 6	72 6	71 6	73 6
Irish: Port Killed	1st	—	—	85 0	86 0	82 6
	2nd	—	—	81 6	82 0	78 0
Argentine Frozen—						
Hind Quarters	1st	67 0	65 6	65 6	67 0	65 6
Fore ,, ...	1st	62 6	63 0	62 0	60 6	62 0
Argentine Chilled—						
Hind Quarters	1st	78 6	78 6	79 6	79 0	79 6
Fore ,, ...	1st	66 6	64 6	66 6	65 6	66 6
Australian Frozen—						
Hind Quarters	1st	65 0	65 6	64 6	64 6	64 6
Fore ,, ...	1st	63 0	62 6	62 0	62 0	62 0
VEAL:—						
British	1st	85 6	85 6	87 0	91 0	84 6
	2nd	80 6	81 6	78 6	81 6	78 0
Foreign...	1st	—	—	—	94 6	—
MUTTON:—						
Scotch	1st	—	—	106 0	101 6	105 6
	2nd	—	—	101 0	97 0	101 0
English...	1st	92 6	100 6	—	94 6	100 6
	2nd	84 6	95 0	—	89 0	94 6
Irish: Port Killed	1st	—	—	102 6	—	98 0
	2nd	—	—	93 6	—	91 0
Argentine Frozen	1st	58 0	59 6	56 6	57 0	56 6
Australian ,, ...	1st	54 6	54 6	53 0	54 0	53 0
New Zealand ,, ...	1st	60 6	60 0	—	61 0	—
LAMB:—						
British	1st	109 6	119 0	112 0	110 0	115 6
	2nd	100 6	109 6	104 0	101 6	105 0
New Zealand	1st	78 0	77 0	77 6	75 6	77 6
Australian	1st	71 0	70 0	70 0	70 6	70 0
Argentine	1st	70 6	70 0	68 0	70 6	68 0
PORK:—						
British	1st	83 6	77 0	78 0	83 0	75 0
	2nd	79 6	74 6	71 6	78 0	70 6
Foreign...	1st	—	—	—	—	—

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in May, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Bristol. First Quality.	Bristol. Second Quality.	Liverpool. First Quality.	Liverpool. Second Quality.	London. First Quality.	London. Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	16 6	15 6	—	—	15 3	14 3
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	144 6	141 6	144 0	141 6	142 6	139 6
„ Factory	133 6	129 6	135 6	130 6	135 6	130 6
Danish...	—	—	154 6	152 6	153 0	150 0
French...	—	—	—	—	138 6	134 6
Russian	—	—	—	—	134 0	130 0
Australian	142 0	139 0	141 0	138 0	139 0	135 6
New Zealand	145 6	142 6	145 6	143 6	145 0	141 6
Argentine	140 6	138 0	138 0	136 0	137 0	134 0
CHEESE:—						
British—						
Cheddar	105 6	100 6	103 6	102 6	105 0	100 0
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	96 0	91 0	101 6	96 0
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	98 0	97 0	—	—	98 0	94 6
BACON:—						
Irish (Green)	96 6	93 0	94 0	91 0	93 0	90 0
Canadian (Green sides)	84 6	80 6	85 6	81 6	85 0	80 6
HAMS:—						
York (Dried or Smoked)	118 0	115 0	—	—	117 0	111 6
Irish (Dried or Smoked)	—	—	—	—	111 0	107 0
American (Green) (long cut)	71 0	68 0	71 0	68 0	74 0	70 0
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British	11 10	11 0	—	—	12 8	11 8
Irish	11 11	11 8	11 9	11 3	12 7	12 0
Danish...	—	—	—	—	13 6	12 6
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
Edward VII.	110 0	92 6	91 6	85 0	102 6	93 0
Langworthy	100 0	90 0	105 0	100 0	111 0	101 0
Up-to-Date	102 6	87 6	86 6	80 0	105 0	95 0
HAY:—						
Clover	—	—	126 0	102 6	110 6	102 0
Meadow	—	—	—	—	104 6	96 0

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	WHEAT.						BARLEY.						OATS.					
	1913.		1914.		1915.		1913.		1914.		1915.		1913.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Jan. 2...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
,, 9...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
,, 16...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
,, 23...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
,, 30...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
,, 13...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
,, 20...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
,, 27...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
,, 13...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
,, 20...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
,, 27...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3...	31	4	31	6	54	6	27	0	25	6	31	9	19	2	18	5	30	6
,, 10...	31	3	31	5	54	9	27	8	26	8	31	3	19	2	18	4	30	4
,, 17...	31	6	31	7	55	4	26	11	25	4	30	10	18	10	18	4	30	5
,, 24...	31	8	31	9	56	5	26	7	26	6	31	5	19	3	18	5	30	11
May 1...	32	2	31	9	58	3	25	11	26	0	32	7	19	6	18	5	31	5
,, 8...	32	6	32	2	60	5	25	9	25	6	33	3	19	6	18	9	32	4
,, 15...	32	10	32	7	61	7	25	4	26	3	34	0	19	9	18	11	32	5
,, 22...	32	10	33	0	62	0	25	3	25	10	34	1	19	11	19	0	32	8
,, 29...	32	7	33	9	61	11	26	1	26	1	34	8	20	1	19	4	32	7
June 5...	32	10	34	0	61	9	26	2	25	11	35	4	19	8	19	4	32	5
,, 12...	32	8	34	1			24	7	24	11			20	2	19	8		
,, 19...	32	8	34	1			23	10	25	10			19	8	19	9		
,, 26...	32	8	34	3			24	3	25	4			19	1	20	0		
July 3...	33	1	34	4			25	2	24	6			21	0	19	9		
,, 10...	33	4	34	2			25	10	24	9			19	4	20	0		
,, 17...	33	6	34	1			24	9	24	2			20	5	19	10		
,, 24...	33	10	34	0			24	1	24	7			20	8	19	9		
,, 31...	34	1	34	2			24	5	25	9			20	3	19	8		
Aug. 7...	34	1	34	9			24	9	25	2			19	0	19	1		
,, 14...	34	3	40	3			24	7	29	4			18	7	25	1		
,, 21...	33	7	38	9			26	5	29	10			18	8	24	3		
,, 28...	32	7	36	2			29	0	30	3			17	10	23	5		
Sept. 4...	31	11	36	5			30	11	30	6			17	8	23	9		
,, 11...	31	9	37	10			31	5	29	11			18	0	23	11		
,, 18...	31	7	38	3			30	9	29	5			17	11	23	8		
,, 25...	31	6	37	6			30	1	29	3			17	9	23	3		
Oct. 2...	31	3	37	1			29	9	29	1			17	10	22	9		
,, 9...	31	0	36	8			29	1	28	10			17	10	22	5		
,, 16...	30	11	36	7			28	8	28	8			17	9	22	4		
,, 23...	30	7	37	2			28	7	28	7			18	0	22	5		
,, 30...	30	1	37	10			28	2	28	3			17	9	23	7		
Nov. 6...	30	0	38	8			28	1	28	6			17	9	23	7		
,, 13...	30	1	39	8			27	8	29	0			17	11	24	8		
,, 20...	30	4	41	0			27	5	29	8			18	1	25	5		
,, 27...	30	9	41	11			27	0	30	3			18	4	25	8		
Dec. 4...	31	2	42	2			26	8	30	2			18	4	25	9		
,, 11...	31	2	42	1			26	5	29	11			18	6	25	9		
,, 18...	31	2	42	7			25	11	29	8			18	5	25	9		
,, 25...	31	0	43	3			25	10	29	9			18	4	25	11		

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley, and Oats** at certain Markets during the Month of May, 1914 and 1915.

—	WHEAT.		BARLEY.		OATS.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
London	33 8	59 10	24 9	34 0	20 6	33 3
Norwich	32 2	60 2	24 8	33 1	18 3	32 1
Peterborough	32 6	60 6	25 11	33 6	19 1	32 5
Lincoln	32 11	61 2	25 6	32 9	19 3	32 4
Doncaster	32 5	60 4	24 2	32 9	18 9	31 5
Salisbury	32 1	59 9	23 9	34 8	18 9	33 4

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

Sutton, M. H. F.—The Effects of Radio-Active Ores and Residues on Plant Life. (15 pp.) Reading: Sutton & Sons [1915]. 2*s.* 6*d.* net. [63·168.]

Herefordshire Education Committee.—Results of a Demonstration on Poor High-lying Arable Land, which had not yielded a paying Crop for Years. (2 pp.) Shirehall, Hereford, 1915. [63·16(04).]

Horwood, A. R.—The Story of Plant Life in the British Isles. Vol. III. (514 pp.). London: J. & A. Churchill, 1915. 6*s.* 6*d.* net. [58·19.]

Dixon, H. H.—Transpiration and the Ascent of Sap in Plants. (216 pp.) London: Macmillan & Co., 1914. 5*s.* net. [58·11.]

Coulter, J. M.—The Evolution of Sex in Plants. (140 pp.) Chicago: University Press. [London: Cambridge University Press], 1914. 4*s.* net. [58·11.]

Board of Education.—School Attendance and Employment in Agriculture. Summary of Returns supplied by Local Education Authorities for the Period 1st September, 1914—31st January, 1915 [Cd. 7881]. (25 pp.) London: Wyman & Sons, 1915. 3*d.* [331.]

North of Scotland College of Agriculture.—Bull. 19:—The Composition and Value of Liquid Manure. (29 pp.) Aberdeen, 1915. [63·163.]

Green, J. L.—Village Industries: A National Obligation. (180 pp.) London: Rural World Publishing Co. [1915]. 1*s.* 6*d.* [63(42).]

Kenny, J.—Intensive Farming in India. (585 pp.) London: Luzac & Co., 1912. 6*s.* [63(024): 63(54).]

Johnson, C. P.—The Useful Plants of Great Britain: a Treatise upon the principal native Vegetables capable of Application as Food, Medicine or in the Arts and Manufactures. [Illustrated by *J. E. Sowerby.*] (324 pp. + XXV. pl.) London: R. Hardwicke, n.d. 25*s.* (second-hand.) [58·19.]

Ohio Agricultural Experiment Station.—Bull. 279:—The Maintenance of Fertility: Liming the Land. (22 pp.) Wooster, Ohio, 1914. [63·15.]

Rhode Island Agricultural Experiment Station.—Bull. 160:—The Comparative Effect on Different Kinds of Plants of Liming an Acid Soil. (407–446 pp.) Kingston, R.I., 1914. [63·15.]

U.S. Department of Agriculture.—Bull. 169:—Injury by Disinfectants to Seeds and Roots in Sandy Soils. (35 pp.) [58·11.] Bull. 186:—A Method of Fumigating Seed. (6 pp.) [63·1951; 63·294.] Washington, 1915.

Royal Commission on Sewage Disposal.—Ninth Report, Vol. I.:—Report. I. Disposal of Liquid Wastes from Manufacturing Processes. II. Disposal of Liquid and Solid Domestic Refuse in Rural Areas. [Cd. 7819.] (190 pp.) 1*s.* 9*d.* Vol. II.:—Evidence and Appendices [Cd. 7820.] (160 pp.) 1*s.* 4*d.* Final Report:—General Summary of Conclusions and Recommendations. [Cd. 7821.] (19 pp.) 3*d.* London: Wyman & Sons, 1915.

Field Crops—

Herefordshire Education Committee.—Farmers' Bull. 9:—Report on the Manuring of Mangels—Season, 1914. (9 pp.) Shirehall, Hereford, 1915. [63·332.]

Hertfordshire County Council Agricultural Sub-Committee.—Leaflet 14:—Report on Potato Experiments at New Ground Farm, Wigginton—Season, 1914. (7 pp.) St. Albans, 1915. [63·512(04).]

Rome, International Institute of Agriculture.—The World's Supply of Wheat and other Cereals, with Supplement, by *Sir James Wilson.* (43 + 18 pp.) Rome, 1915. [63·31:31.]

Rome, International Institute of Agriculture.—Statistical Notes on the Production, Imports and Exports, Prices and Maritime Freights of Cereals. (47 pp.) Rome, 1915. 25 centimes. [3459, A. 51.] [63·31:31.]

Taylor, E. R.—The Cultivation of Sugar Beet and Manufacture of Beet Sugar in the British Isles. (31 pp.) Liverpool: Incorporated English Beet Sugar Pioneer Association, 1915. [63·3432; 664·1.]

U.S. Department of Agriculture.—Farmers' Bull. 646:—Crimson Clover: Seed Production. (13 pp.) Washington, 1915. [63·33(*b*).]

Horticulture—

Thomas, H. H. [edit.]—Gardening for Amateurs: A Simple, Complete and Practical Guide for Garden Lovers. 4 vols. (1136 pp.) London: Waverley Book Company [1915.] £1 8*s.* 6*d.* the 4 vols. [63·52.]

Brett, W.—War-Time Gardening: How to grow your own Food. (64 pp.) London: "The Smallholder" [1915.] 6*d.* net. [63·5(02).]

Plant Diseases—

Stebbing, E. P.—Indian Forest Insects of Economic Importance—*Coleoptera.* (648 pp. + LXIII. pl.) London: Eyre & Spottiswoode, 1914. 15*s.* [63·27–49.]

Ontario Department of Agriculture.—Bull. 229:—Smuts and Rusts of Grain Crops. (24 pp.) Toronto, 1915. [63·24.]

Wisconsin Agricultural Experiment Station.—Circ. 52:—Control of Potato Diseases in Wisconsin. (19 pp.) Madison, Wis. 1914. [63·24–33; 63·27–33.]

Delaware Agricultural Experiment Station.—Bull. 105:—The Composition of Lime-Sulfur Solutions. (30 pp.) Newark, Delaware, 1914. [63·295.]

Live Stock—

Townshend, G. A.—Practical Rabbit Keeping. (299 pp.) London: Cassell & Co., 1912. [63·69.]

Gay, C. W.—The Principles and Practice of Judging Live Stock. (413 pp.) New York and London: The Macmillan Co., 1914. 6*s.* 6*d.* net. [63·6(064).]

Porter, J.—The Stockfeeder's Companion. (XX. + 316 pp.) London: Gurney and Jackson, 1915. 3*s.* 6*d.* net. [63·604.]

R. S. Timmis.—Modern Horse Management. (233 pp.) London: Cassell & Co. [1915]. 12*s.* 6*d.* net. [619·1; 63·61(02).]

Ohio Agricultural Experiment Station.—Bull. 270:—Experiments in Winter Lamb Production. (199–223 pp.) Wooster, Ohio, 1914. [63·63.]

Wyoming Agricultural Experiment Station.—Bull. 103:—I. Corn *v.* Barley in Lamb Rations. II. Methods of Feeding Barley to Lambs. (7 pp.) Laramie, Wyoming, n.d. [63·63.]

Dairying and Food, General—

U.S. Department of Agriculture.—Bull. 148:—The Use of Bacillus Bulgaricus in Starters for making Swiss or Emmental Cheese. (16 pp.) Washington, 1915. [63·736.]

Wisconsin Agricultural Experiment Station.—Research Bull. 33:—(*a*) Comparative Efficiency for Growth of the Nitrogen of Alfalfa Hay and Corn Grain; (*b*) The Comparative Efficiency for Milk-Production of the Nitrogen of Alfalfa Hay and Corn Grain. (87–119 pp.) Madison, Wisc., 1914. [63·604(*a*); 63·711(*a*).]

Birds, Poultry, and Bees—

Powell-Owen, W.—The Intensive System of Poultry Keeping. (42 pp). London: Poultry Press. 6*d.* net. [63·651(04).]

West of Scotland Agricultural College.—Bull. 64:—Poultry Keeping. (109–171 pp.) Glasgow, 1914. [63.65(02).]

New South Wales, Department of Agriculture.—Farmers' Bull. 93:—Sixth Annual Conference of Poultry Farmers, Hawkesbury Agricultural College, June, 1914. (16 pp.) Sydney, 1914. [63.65(944).]

U.S. Department of Agriculture.—Farmers' Bull. 624:—Natural and Artificial Brooding of Chickens. (14 pp.) Washington, 1914. [63.6: 69; 63.651(04).]

Robinson, J. H.—Principles and Practice of Poultry Culture. (611 pp.) Boston: Ginn & Co., 1912. [63.65(02).]

Harper Adams Agricultural College.—Bull. 1 of 1915:—Report of the Second Twelve Months Poultry Laying Competition carried out in conjunction with the Utility Poultry Club. (84 pp.) Newport, Salop, 1915. 2*d.* post free. (63.651(04).]

U.S. Department of Agriculture, Bureau of Animal Industry.—Bull. 110, Part III.:—A Biometrical Study of Egg Production in the Domestic Fowl. III.—Variation and Correlation in the Physical Characters of the Egg. (171–241 pp.) Washington, 1914. [63.651(04); 63.74.]

U.S. Department of Agriculture.—Farmers' Bull. 630:—Some Common Birds Useful to the Farmer. (27 pp.) Washington, 1915. [59.162.]

U.S. Department of Agriculture.—Bull. 171:—Food of the Robins and Bluebirds of the United States. (31 pp.) [59.162.] Bull. 187:—Preliminary Census of Birds of the United States. (11 pp.) [59.82.] Washington, 1915.

Watson, J. [edit.].—Farm Vermin: Helpful and Hurtful. (85 pp.) London: W. Rider & Son, n.d. 2*s.* 6*d.* [63.269.]

Forestry—

Moon, F. F. and *Brown, N. C.*—Elements of Forestry. (392 pp.) New York: J. Wiley & Sons; London: Chapman & Hall, 1914. 8*s.* 0*d.* net. [63·49(022).]

Maxwell, Sir H.—Trees: A Woodland Notebook. (235 pp.) Glasgow: J. Maclehose & Sons, 1915. 21*s.* net. [63·49: 58.]

Burt, E. A. P.—The Railway Rates Standard Timber Measurer. (323 pp.) [3rd Edition.] London: W. Rider & Son, n.d. 4*s.* net. [63.49·198.]

Chapman, H. H.—Forest Valuation. (310 pp.) New York: J. Wiley & Sons; London: Chapman & Hall, 1915. 8*s.* 6*d.* net. [63.49: 31; 63.49(021).]

Bunyard, G.—Handbook of Hardy Trees and Shrubs. [The Planters' Handbook.] (160 pp.) Maidstone: G. Bunyard & Co., 1908. 3*s.* 6*d.* net. [63.498.]

Engineering—

Savage, W. G.—Rural Housing. (297 pp.) London: T. Fisher Unwin, 1915. 7*s.* 6*d.* net. [333·32; 69(02).]

Ohio Agricultural Experiment Station.—Circ. 147:—The Cost of Tile Drainage: A Study of the Cost of Installing Thirty-five Miles of Tile Drains in Huron County, Ohio. (21–44 pp.) Wooster, Ohio, 1914. [63·14.]

Widtsoe, J. A.—The Principles of Irrigation Practice. (496 pp.) New York and London: The Macmillan Co., 1914. 7*s.* 6*d.* net. [63.13.]

Washington Agricultural Experiment Station.—Bull. 117:—Report on Fires occuring in Threshing Separators in Eastern Washington during the Summer of 1914. (22 pp.) Pullman, Washington, 1914. [63.17.]

Martin, E. A.—Dew Ponds: History, Observation and Experiment. (208 pp.) London: T. Werner Laurie. [1915.] 6*s.* net. [628.7.]

Economics—

Brooks, T. J.—Markets and Rural Economics: Science of Commerce and Distribution. (397 pp.) New York: The Shakespeare Press, 1914. [338·1.]

Ham, A. H., and *Robinson, L. G.*—A Credit Union Primer. (79 pp.) New York: Russell Sage Foundation, 1914. 25 cents. [332·71(04).]

Carver, T. N.—Principles of Rural Economics. (386 pp.) Boston [U.S.A.]: Ginn & Co., 1911. 5*s.* net. [338·1.]

Inter-denominational Conference of Social Service Unions.—Land and Labour: being a Series of Lectures given at Swanwick, Derbyshire. June 10th–20th, 1914. (167 pp.) London [1915], 2*s.* 6*d.* [331; 338·1.]

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 4.

JULY, 1915.

THE UTILISATION OF CEREAL OFFALS AND CERTAIN OTHER PRODUCTS FOR FEEDING PURPOSES.

SINCE the outbreak of war, feeding stuffs in general have considerably increased in price, and the farmer who wishes to obtain the most profitable results from his stock will find it necessary to compare carefully the food unit prices of all the food-stuffs available. This is all the more important because in the case of a number of feeding stuffs, especially those which were largely exported before the war, the increase in price has been relatively small, and the stock feeder will be well advised to consider the possibility of utilising some of these more extensively in making up the rations for his stock. Provided it is borne in mind that all changes in stock feeding should be gradual, and that new feeding stuffs should be introduced at the beginning rather than at the end of the feeding period, it will be found that many of the feeding stuffs described in the present article may be substituted advantageously for some of the better known feeding stuffs in general use before the war.

The table on p. 298 gives the present average price and the cost per food unit of 30 feeding stuffs now on the market. The list does not include proprietary articles, such as some of the mixed cakes and sugar feeds, for the reason that such articles have no definite average composition on which an estimate of their content of food units can be based. Anyone, however, who proposes buying such feeding stuffs can make a rough calculation of the food units in the usual way, from the guaranteed analysis of the maker or

seller. From the number of food units thus calculated, about one-fifth should be subtracted in order to get a rough estimate of the number of digestible food units. The price per ton, divided by this final figure, will then give the price per unit for comparison with the standard foods given in the following list. Full particulars of the methods recommended for comparing the value of feeding stuffs by reducing them to food units are given in Leaflet No. 74 (Composition and Properties of Concentrated Feeding Stuffs) which should be read in conjunction with the present article.

—	Average price per ton at beginning of July.			Price per food unit.*	
	£	s.	d.	s.	d.
Brewers' grains (wet)	1	0	0	0	11½
Soya bean cake	8	3	0	1	4
Maize gluten feed	8	4	0	1	4¼
Palm-nut kernel cake	6	0	0	1	5¼
Coconut cake	7	9	0	1	5½
Wheat pollards	6	0	0	1	5¾
Brewers' grains (dry)	6	6	0	1	6
Wheat bran	5	16	0	1	6
Decorticated cotton cake	9	13	0	1	6¼
Wheat middlings..	7	6	0	1	6¾
Linseed cake, Indian	9	15	0	1	7
Malt culms	5	16	0	1	8
Wheat bran, broad	6	14	0	1	8
Maize, Argentine	8	0	0	1	8¼
Rice meal, Burmese	6	13	0	1	8¼
Linseed cake, English	10	6	0	1	8¾
Maize germ meal	8	13	0	1	9
Wheat sharps	7	15	0	1	9½
Maize, American	8	10	0	1	9¾
Beans, Chinese	9	17	0	1	11¼
Cotton cake, Egyptian	7	1	0	1	11½
Beans, English	9	15	0	1	11½
Maize meal	8	12	0	1	11¾
Peas, English dun	9	18	0	2	0½
Cotton cake, Bombay	6	15	0	2	0¾
Peas, English maple	10	11	0	2	2
Barley, English feeding	10	0	0	2	5
Oats, Argentine	10	7	0	2	9
Peas, Calcutta white	13	13	0	2	9½
Oats, English	11	14	0	3	1¼

* Calculated on basis of digestible constituents of feeding stuffs (*see* Leaflet 74, p. 8).

It should be understood that the results are based on the average price of an average sample. No allowance is made for differences in prices at the various markets, or for variation in the composition of different samples of the same feeding stuff. The table will serve, however, as a broad indication of the

relative food unit values of food-stuffs at present prices, and by using it as a general guide, the farmer may easily compare for himself the prices of particular food-stuffs relative to their feeding value if he will make use of the methods described in Leaflet No. 74.

The feeding stuffs dealt with in this article are :—

1. Wheat Bran.
2. Sharps and Middlings.
3. Wet Grains.
4. Dried Grains.
5. Malt Culms.
6. Dried Yeast.
7. Gluten Meal and Gluten Feed.
8. Maize Germ Meal.
9. Rice Meal.
10. Soya Bean Cake and Meal.
11. Coco-nut Cake.
12. Palm-nut Kernel Cake.
13. English Beans.
14. Fish Meal.

1. *Wheat Bran.*—Bran is one of the principal "offals" obtained in the milling of wheat. Two forms of bran are sold—the "broad" and the "medium." The former consists mainly of the larger flaky particles of the outer coats of the wheat grain, and especially finds favour for feeding horses; the latter, which consists of the finer particles of the same material, constitutes the bulk of the bran made in this country, and is used mainly for dairy cattle. In composition bran closely resembles the other wheat offals, viz., sharps and middlings, and is not unlike oats. The manurial value of bran, however, is higher than that of oats; according to Hall and Voelcker, the respective values per ton of bran and oats when made into dung are 31*s.* 3*d.* and 17*s.* 11*d.*

Bran is particularly rich in mineral ingredients (lime and phosphates), and it is therefore specially well suited for young growing animals and for brood animals of all kinds both before and after parturition. It is a very palatable food, and this fact, coupled with its well-known laxative influence, peculiarly fits it for feeding in association with such concentrated foods as cotton cakes, bean meal and maize, or with coarse fodders, such as wheat or barley straw, when the supply of roots is restricted. In experiments conducted by the Edinburgh and East of Scotland College of Agriculture in 1910-11 and 1911-12, with two-year-old fattening bullocks, bran proved equal to linseed cake in

respect of the quantity and quality of the beef produced, and was slightly the more profitable feeding stuff. In America, bran has been extensively used as a partial substitute for oats in feeding heavy horses, and has resulted in a very considerable saving in the cost of maintenance. It was found that these two foods might suitably be mixed in equal proportion for horses. At present prices the feeding of broad bran seems to be extravagant.

2. *Sharps and Middlings.**—Sharps is a wheat offal of a grade intermediate between bran and middlings, and it consists, mainly, of fine particles of bran with a certain amount of adherent meal. Middlings represents the innermost layers removed from the wheat grain when making flour, and this offal closely approaches flour in its general character. Sharps contains as a rule slightly more fibre than middlings, but in all other respects the two are very much alike in composition and may conveniently be considered together. In general character and feeding properties they closely resemble bran; they are rather more nutritious than bran, but lack some of the special qualities possessed by that feeding stuff. Sharps and middlings are mainly used in the feeding of pigs and poultry.

Probably these offals constitute the safest "dry" food for pigs for a few weeks both before and after weaning, and also for sows suckling their young. For young pigs they are best fed along with skim milk, buttermilk or whey. After weaning an excellent ration consists of these by-products of the dairy with a mixture of bran or sharps and barley meal. When no dairy by-products are available, a mixture of brewers' grains (fresh), barley meal and bran or sharps may safely be used.

3. *Wet Grains.*—This food is a by-product of the brewing and distilling industries, and represents the residues of the grains (chiefly barley) which have been converted into malt and subjected to thorough extraction with water. It contains all the husk of the barley, a considerable proportion of which is digestible, and also the bulk of the albuminoids or flesh-forming substances present in the original grain; the greater part of the starch will have been removed. It is the

* *There is considerable divergence in the grading of milling offals in different parts of the country, but for general purposes they may be grouped into the three classes of bran, sharps (or shorts) and middlings (thirds), the last named being the most like flour in character, whilst sharps (or pollards) are intermediate between this and bran.*

cheapest per food unit included in the table, and is largely used for feeding dairy cows. It is very palatable, and the low cost of the food is due to the fact that the difficulties of carriage restrict the consumption of the grains to the neighbourhood of breweries or distilleries, and to the fact that it varies very much in composition. In using wet grains special care must be taken that they are delivered fresh, and that no more are given to the animals than can be consumed without causing scour. Over-feeding, especially after storage, is apt to lead to digestive disturbances. Where cleanliness and supervision of feeding are exercised, this feeding stuff is very economical for the production of milk. It is largely used in Holland for fattening old cows for beef.

Occasionally fresh grains are stored in pits for subsequent use in much the same way as silage is preserved. In such cases a little salt is usually mixed with the grains.

4. *Dried Grains.*—For convenience of sale and storage wet grains are frequently dried by machinery.

As a feeding stuff, dried grains are intermediate between undecorticated cotton cake and sharps; in round figures the relative feeding values of the three may be placed at 4 : 5 : 6. There is a good deal of difference of opinion as to the relative feeding value of distillers' grains and brewers' grains. The former are generally the more expensive to buy but if the foods are judged by their chemical composition, there can be very little difference between the two. It must be remembered, however, that while chemical analysis is useful as a guide, it does not afford complete information as to the relative feeding value of different commodities.

Dried grains are much liked by stock and are generally recognised as an excellent feeding stuff for fattening cattle, milking cows, and especially for suckling ewes and growing lambs. As a food for horses they are perhaps less widely known; theoretically 6 to 7 lb. of dried grains should equal 5 lb. of oats, but numerous experiments both in America and on the Continent have shown that, pound for pound and in moderate quantities, they may be equal to oats for feeding horses at ordinary work. At present they are very much cheaper per food unit. Dried grains are quite wholesome and should be given a trial when easily obtainable. Their manurial value consumed at the homestead is, according to Hall and Voelcker, 29*s.* per ton.

5. *Malt Culms.*—Malt culms, or coombs, consist of the dried rootlets and shoots screened from the kilned malt. High quality culms are light coloured, crisp and nearly free from dust; they possess a pleasant aromatic smell. They vary widely in composition, but may contain about 26 per cent. of crude albuminoids, 1 per cent. of oil, 46 per cent. of carbohydrates and 11 per cent. of fibre. It should be noted, however, that a considerable proportion of the ingredients classed as crude albuminoids are not "true albuminoids," but possess a relatively low nutritive value. Malt culms are highly palatable and digestible and are readily eaten by all classes of stock. They impart a relish to less appetising foods, and are specially suitable for feeding to sheep and dairy cows. Malt culms may be fed in the same way as dried grains and in somewhat similar quantities.

A word of warning is necessary against feeding excessive quantities of malt culms, as they are apt to lead to digestive trouble and may cause abortion in breeding animals approaching parturition. The use of dark coloured culms and culms containing large amounts of dust and other impurities should be avoided. Provided, however, that care is taken to use only good quality culms, farmers will find in them a valuable and economical feeding stuff.*

6. *Brewers' Dried Yeast.*—This by-product of brewing is widely utilised on the Continent as a feeding stuff for cattle and pigs. It contains approximately 48·5 per cent. of albuminoids, ·5 per cent. of oil and 35 per cent. of carbohydrates. The percentage of ash (mainly phosphates) is high. This feeding stuff has not hitherto been much used in England, but its composition, and the fact that it has given excellent results with all classes of live stock on the Continent, show that it is clearly worth the attention of farmers in this country.

7. *Gluten Meal and Gluten Feed.*—These feeding stuffs are residues from the manufacture of starch from maize and one or two other cereals. The former consists mainly of the gluten layer, and is therefore rich in albuminoids. Gluten feed, on the other hand, is the result of a less complete separation of the gluten layer, and contains more fibre and less albuminoids than the meal. Both "meal" and "feed" are fairly rich in oil, but are relatively poor in mineral matter.

Gluten meal is largely used in this country as a nitrogenous ingredient in compound feeding cakes, and is to some extent fed alone to dairy cows. Both of the by-products are

* Information in greater detail as to the feeding of malt culms is given in this *Journal* for June, 1915, p. 239.

extensively used in America and on the Continent for feeding to fattening stock and to dairy cows, the best results being obtained when they are given in conjunction with other concentrated foods. In mixtures they are also suitable for feeding sheep, pigs and poultry. Gluten meal and gluten feed may be used in part to replace beans and peas, which they resemble in composition.

In the few cases in which gluten feed has been used extensively in this country it has given very good results when fed up to 5 lb. daily. In the United States, where it is always fed in conjunction with a light material such as wheat bran, it has been fed with excellent results for dairy cattle and fattening stock.

8. *Maize Germ Meal.*—This meal is prepared by removing the germ from the maize grain and grinding it up separately. It usually contains about twice as much oil as the maize grain itself and slightly more albuminoids. The carbohydrates in the germ meal, which are about 10 per cent. less than in the maize grain, comprise, in addition to starch, a certain amount of sugar. It is this sugar which imparts to the meal its characteristic sweetness. Maize germ meal is a favourite feeding material, particularly for dairy cows.

9. *Rice Meal.*—In preparing the rice grain for human food the outer husks, commonly known as "rice hulls" or "rice shudes," are removed first. These "hulls" or "shudes," which consist principally of woody fibre and are often adulterated with a large amount of siliceous or sandy material, are of little or no feeding value and may even be positively harmful. It is important therefore that they should form no part of rice meal, which should consist of the reddish or bran layer immediately enclosing the white grain of commerce, together with broken pieces of the grain itself.

Rice meal is essentially a starchy food. It is also rich in oil, but it is probable that this is of relatively low feeding value. The meal is particularly valuable for mixing with beans, decorticated cotton cake or with soya bean cake. It should *not* be used with common cotton cake. Rice meal is useful for pig feeding and may form part of the ration of fattening bullocks. It may also be used to replace to some extent cereal grains in rations for horses. Care should be taken to avoid samples containing more than about 2 per cent. of siliceous material, and, in view of the liability of the meal to turn rancid, large stocks should not be stored.

10. *Soya Bean Cake and Meal.*—Soya bean cake is made from the bean of a leguminous plant (*Soya hispida*). This bean has long been extensively grown in the East, where it forms an important article of human food, but only since 1908 has it been imported in quantity into this country. It differs from the common field bean in being rich in oil. To a small extent the soya bean itself is used as a cattle food, but, as a rule, the greater part of the oil is first removed by seed crushers, the residual cake or meal being used for feeding purposes. In the ordinary course the oil is removed by heat and pressure, the residue being in the form of a cake which still contains a considerable percentage of oil. A soya bean meal, however, is also sold, and from this nearly the whole of the oil has been extracted by means of a chemical solvent.

Soya bean cake usually contains 40-45 per cent. of albuminoids and 6-8 per cent. of oil. It can be mixed without danger with maize gluten feed, and a combination of bean and rice meal. It is usually fed in combination with common cotton cake. At present prices it is a very cheap feeding stuff, but should be fed with discretion as it possesses distinctly laxative, not to say scouring, properties. It is suggested that it should never exceed one-fourth of the concentrated ration. "Extracted" meal is much poorer in oil than the cake, containing only about 2 per cent., but it is correspondingly richer in albuminoids. It should be fed in moderate quantities along with other less concentrated foods. Soya bean cake and meal have a high manurial value, similar to that of decorticated cotton cake, and considerably higher than that of linseed cake.

11. *Coco-nut Cake.**—Coco-nut cake is made from the fleshy portion of the coco-nut after the oil has been extracted. It is not largely used for feeding in this country but is in considerable request on the Continent.

An average sample of coco-nut cake may contain 22 per cent. of albuminoids and 10 per cent. of oil; it is thus not so rich in flesh-forming substances as linseed cake, but in other respects is not dissimilar to that feeding stuff. On the Continent coco-nut cake is favoured as a food for dairy stock. It is damped before use and fed in quantities of from 3 to 4 lb. a day; it is said to be eaten readily. Sufficient data as to its suitability for stock feeding in this country have not yet been accumulated. Theoretically it should be about

* *See also* Special Leaflet No. 20 (*Coco-nut Cake and Palm-nut Kernel Cake*).

equal to linseed cake, and, at present prices, farmers would be well advised to use it as a substitute for more expensive foods in the concentrated rations for dairy cows, and they should certainly give it a trial in feeding for meat production.

12. *Palm-nut Kernel Cake.**—Palm-nut kernel cake is made by pressing the kernels of the nuts of the oil palm, a species of palm that is grown extensively in the West African Colonies and Protectorates. Almost the whole export of this product has hitherto gone to Germany, where large factories have been erected for crushing the kernels and preparing the products for market. It is hoped that it may now be possible to arrange for the crushing of palm-nut kernels in this country. The kernel contains about 50 per cent. of oil, and after crushing is sold in the form of either cake or meal containing about 7 to 8 per cent. of oil and 17 to 18 per cent. of albuminoids. The meal is sometimes further treated with chemical solvents and its content of oil may then be reduced to as little as 1·5 per cent.

Palm-nut oil, which is largely used for human food, is very suitable for certain classes of stock, but there is not sufficient information available to enable a definite comparison to be made between palm-nut and linseed oils. The experience of foreign stock-feeders would appear to indicate that palm-nut kernel cake would make a very good substitute for linseed cake in feeding dairy cattle. Cows may receive up to 5 lb. per head per day.

Palm-nut kernel cake does not keep so well as linseed or cotton cakes, and users should not lay in large stocks.

13. *English Beans.*—Beans are much cheaper per food unit than the cereal grains, and may be fed to advantage in conjunction with any laxative concentrated food. Beans should be used with discretion as they are very binding. With linseed cake they form a very popular finishing ration.

14. *Fish Meal.*—Fish meal is produced from fish offal, and from whole fish which is unsaleable owing to an excessive supply. Provided it has been carefully prepared, fish meal forms a suitable supplementary feeding stuff for farm animals, and may be used with advantage for cattle, pigs and poultry. As most of the fish meal manufactured in England has hitherto been taken by the Continent, it is likely

* *See also* Special Leaflet No. 20 (*Coco-nut Cake and Palm-nut Kernel Cake*).

that it will now be available in some quantity, and that farmers may find it a cheap feeding stuff. The richness of fish meal in protein (55 to 65 per cent.), of which a considerable proportion is easily digestible, renders it specially suitable for combination with other foods relatively poor in this ingredient, such as roots, potatoes, hay, straw, and the starchy cereal grains and offals. If fed in too large quantities, or if it contains too high a percentage of oil, both meat and milk are liable to be tainted. High grade fish meal should not contain more than 3½ to 5 per cent. of oil. Among the mineral constituents present are phosphate of lime and salt, both of which are necessary in the feeding of farm animals. In the case of salt, however, an excess may cause illness, especially in pigs, and for this reason the proportion of salt in fish meal should not exceed 5 per cent. As a result of the experiments which have been conducted by stock-feeders it is suggested that the following quantities might be given daily to the different kinds of farm stock:—

Cattle—2 lb. for every 1,000 lb. live weight.
Pigs—¼ to ½ lb., according to weight.
Sheep—$\frac{1}{10}$ to $\frac{1}{5}$ lb. for every 100 lb. live weight.

For poultry feeding, fish meal with a low percentage of oil and salt should be selected, and the birds should be gradually accustomed to the food. Adult fowls should receive not more than 10 per cent., and chickens not more than 5 per cent. of their whole diet in this form.*

Compiling Rations.

In compiling rations for the various classes of live stock it is desirable to select those feeding stuffs which, although not necessarily the cheapest absolutely, are the cheapest for the purpose in view. Where an abundant supply of grass or similar succulent green fodder is available, it is not usually necessary in the case of ruminant animals, or animals at slow and easy work, to feed much concentrated food in addition. The chief use of a concentrated food is to supplement one or more of the ingredients that may not be present in sufficient quantity in the fodder upon which the animal is feeding.

As autumn approaches, pastures usually begin to fail, or at all events they become less sustaining by reason of the

* Further information as to the feeding value of fish meal will be found in this *Journal* for November, 1914, p. 688.

fact that a large proportion of the plants then reach maturity. It usually becomes necessary, therefore, at this time to add to the food ingredients of the diet by the use of concentrated feeding stuffs. The chief requirement in this respect is generally albuminoids.

For dairy cows, a judicious blend of two or more of the following feeding stuffs will probably be found the most suitable and economical at the present time :—Linseed cake, coco-nut cake, maize gluten feed and brewers' grains. For well-grown store cattle a selection, preferably a blend, may be made from soya bean cake, linseed cake, dried grains and cotton cake. Calves suckling, or on the pail, or newly weaned, may be pushed forward by a moderate allowance of linseed cake, bran and crushed maize.

A suitable lamb food may consist of linseed cake or bean meal, crushed maize, dried grains, and rice meal. For ewes in improving condition at tupping time, a little linseed cake and crushed maize, or "tail" oats, would form a suitable addition to the usual pasturage. For horses at farm work the ration may consist of sharps, maize and bean meal, with a little bran in addition if no green forage is available.

Growing pigs and breeding sows will obtain much of the sustenance required from vegetable foods such as clover, vetches, lucerne and rape. Later, waste potatoes will be available for this purpose. All such food may be supplemented by "tail" corn, wheat offals and rice meal. Fattening stores may be fed largely on sharps with the addition of some food rich in albuminoids, such as palm-nut kernel meal or dried yeast.

GROUND NUT CAKE.

THE ground nut, earth nut, monkey nut or pea nut (*Arachis hypogaea*) is grown in most of the tropical and subtropical regions of the world, and to a certain extent in countries where a temperate climate prevails. The chief countries from which ground nuts are exported are, in order of importance, India, Senegal, Gambia, China and Nigeria. A slowly but steadily increasing production has taken place in the tropical parts of the British Empire in recent years. The chief importing countries for ground nuts, in order of importance, before the war, were France, Germany and Holland, and the most important crushing centres, also in order of importance, were Marseilles, Bordeaux, Dunkirk, Hamburg and Delft.

The ground nuts imported into the United Kingdom prior to the war were mainly used either in confectionery (as a cheap substitute for almonds and pistachio nuts) or as edible nuts; on the Continent they are chiefly used as a source of oil and of feeding cake for stock. The nuts are now being crushed on a small scale in the United Kingdom, and ground nut cake of British manufacture will be on the market shortly.

The oil is obtained either by pressing or extraction. The pressing seems to be carried out in three distinct stages: the first (cold) pressing gives an almost colourless oil of pleasant taste and smell which is largely used for table purposes and in the manufacture of margarine; the oil from the second pressing (either cold or warm) is sometimes fit for table purposes, but is mostly used for burning; and that from the third (warm) pressing is a yellowish oil of less pleasant taste and smell, which is used in the manufacture of soap. When the oil is only to be used for the manufacture of soap the whole is usually extracted by chemical means, and as the nuts must then be previously ground, the residue after extraction is in the form of meal.

Only in the case of the very best ground nut cake are the nuts shelled in Europe, and in this case most of the seed-coat is removed in the process. Most of the cake is made from Indian-shelled nuts, in which case only the shell is removed, not the seed-coat and germ. Ground nuts obtained from China and Africa are, as a rule, of much better quality than those exported from India. The last-named, owing to the native practice of wetting them, generally arrive in Europe

in bad condition and yield a dark-coloured cake, much of which can be used only as manure. Efforts are, however, now being made to improve the quality of the Indian exports.

Colour, etc.—Samples of the cake vary in colour from an almost pure white to a grey or grey-brown. The more nearly the colour is pure white, the better is the sample and the smaller is the likelihood of adulteration. (Good cold-pressed cake from decorticated nuts is white or light grey-brown). Yellow or grey-yellow cakes and dark-coloured meals should be suspected of being the produce of nuts mostly spoilt by fermentation and possibly adulterated. Good cake from unspoilt nuts has a sweet, pleasant, bean-like taste, and a fresh, oily smell; the latter, however, is easily lost as the fat has a great tendency to go rancid (some experimenters, however, think that cake with a high fat content keeps better than one with a low). The effect of warm pressing is to give the cake and meal therefrom a red appearance, as the reddish seed coat is then broken up finely, whereas in cold-pressed cakes it is present in large pieces and recognisable as red spots.

Composition.—Analyses of decorticated ground nut cake show that this feeding stuff is very rich in protein. Rufisque cake is usually sold in Germany with a guaranteed minimum of 48 per cent. of crude protein (over 50 per cent. is often found), with 6 to 9 per cent. of fat, about 25 per cent. of carbohydrates, and less than 1 per cent. of sand; while ordinary decorticated samples are usually guaranteed to contain 46 per cent. of crude protein and 7 to 8 per cent. of fat, and they contain in addition up to 9 per cent. of fibre and from 2 to 3 per cent. of sand.

The following analyses are given by various authorities:—

——	Moisture.	Oil.	Crude Protein.	Carbo-hydrates.	Crude Fibre.	Ash.
Ground Nut Cake:	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Kellner:						
Decorticated..	9·8	9·2	44·5	23·8	5·2	7·5
Rufisque ..	9·0	7·0	50·8	24·3	4·4	4·5
Pott:						
Decorticated..	10·00	7·30	48·00	24·50	5·00	5·2
Undecorticated	11·00	9·00	31·00	19·50	23·50	6·0
Voelcker:						
Decorticated..	10·43	8·17	48·32	22·99	4·67	5·42
Undecorticated	11·60	7·17	28·50	28·06	18·97	5·70
Smetham:						
Decorticated..	10·60	7·73	49·31	21·71	4·70	5·95

Digestibility.—As regards digestibility it seems to be accepted that both protein and fat in decorticated ground nut cake are about 90 per cent. digestible on the average; the figure given for the average digestibility of the carbohydrates varies—it has recently* been placed at 93 (Kellner's figure is 84). The following are Kellner's figures for digestible constituents of decorticated cakes compared with those for other foods:—

—	Oil.	Crude Protein.	Carbo-hydrates.
	Per cent.	Per cent.	Per cent.
Ground Nut Cake, decorticated:			
Ordinary	8·30	40·00	20·00
Rufisque	6·30	46·70	20·60
Decorticated Cotton Cake	8·46	35·26	17·42
Undecorticated Cotton Cake	5·11	16·94	17·68
Linseed Cake	9·20	25·80	26·52

According to Voelcker the ash contains 7·62 per cent. of nitrogen, 2·0 per cent. of phosphoric acid and 1·5 per cent. of potash. The residual manurial value is high: adopting Hall and Voelcker's scale, the value works out at 66*s.* 2*d.* per ton if made into dung, and 89*s.* 1*d.* per ton if consumed on the land. These are higher figures than for any other food shown in Hall and Voelcker's Tables. Ground nut cake used in England in the past has at times contained excessive amounts of sand and earthy matters.

Feeding Value.—Decorticated ground nut cake would form a suitable substitute for decorticated cotton cake, and can be used for all classes of stock to add to rations which are poor in protein. If of good quality it is readily eaten by all animals. The best results are obtained from its use when fed in moderate quantities and introduced into the ration gradually, in which case it has no effect on the taste of milk or meat.

For *dairy cows*, up to 3½ lb. per head per day can be recommended; the milk and butter are said to suffer in flavour with larger quantities; with small quantities some experimenters report a favourable effect on the quality of the butter. Ground nut oil was added to the ration of dairy cows in an experiment at Wye College without producing any appreciable difference in the yield of milk or percentage of fat. From 2 to 4 oz. per head per day improved the flavour of winter butter, but larger quantities made the cream difficult to churn and the butter was soft in texture.

* *Illustriertes Landwirtschafts Lexicon*, 1910.

Fattening cattle may be given up to 4½ lb. per head per day; and fattening calves may receive up to 1½ lb. per head per day. Excellent results have been obtained in the Bremen district by feeding calves with a gruel made up with decorticated ground nut cake, separated milk and warm water. Experiments at Woburn in 1892 with fattening bullocks showed that the cake could replace beans in a mixed diet and give as satisfactory results.

Pigs may be given up to 2 lb. per head per day, and a firm bacon of good quality is said to result from the feeding. Care must be taken to begin with very small quantities.

It would probably be best not to give *sheep* more than from ½ lb. to 1 lb. per head per day.

For *horses* ground nut cake seems to have been found specially suitable, and numerous experiments have been made in which this food has satisfactorily replaced part of the oats ration for horses. Thus in a ration of 12 lb. of oats 4 lb. of the oats might be replaced by 2 lb. of ground nut cake, or 6 lb. of the oats by 3 lb. of ground nut cake. In Schleswig Holstein it is usual to begin by replacing 1 lb. of oats by ½ lb. of ground nut meal, and gradually increase this amount. It has further been used in many cavalry regiments in the German army with good results. If the cake is given to horses it is best fed crushed, and either spread out dry over their other foods or mixed with the latter.

Ground nut cake sometimes causes constipation; where this is found to be the case it could be remedied by regulating the other foods in the ration.

Possible Danger from Feeding Ground Nut Cake.—While the high protein content is largely responsible for the high feeding value of the cake it is also a source of danger, favouring the production of harmful decomposition products, though this can, as a rule, only occur when nuts in bad condition are used for making the cake. In a case of poisoning of cows investigated at the Kiel Veterinary Institute the cause was found to be the presence of these decomposition products of the protein of earth nut cake. Decomposition is liable to set in where the nuts have been shelled before transport, but where it does occur it is almost entirely confined to Indian nuts and is due to the wetting of the nuts before they are shipped. Faulty storage of the cake or meal is also likely to cause decomposition. Pott insists that decorticated cakes of which the protein content falls below 47 per cent. should

a priori be regarded with suspicion as being spoilt or coming from spoilt nuts; and that suspicion should increase when the cake contains relatively much amide nitrogen and little sugar.*

Besides the protein decomposition products, cakes may contain rancid fat, decomposed starch, alkaloids, mould organisms and insect larvæ. There have been many instances of animals steadily refusing ground nut cake even though it appeared clean and unspoilt, and this may have been due to one or other of the factors mentioned. If the cakes have a rancid, bitter, or sharp taste they should certainly not be fed to animals; and if there is any doubt on the point they should be cooked and fed to fattening and draught animals, and not to dairy cows, breeding animals and young animals.

Adulteration of the cakes and meals has been practised in the past, and inferior samples may be due to this cause. Both undecorticated cake and meal are more easily adulterated than decorticated cake, but the two former seem to be disappearing from the oil cake trade.

Numerous instances have occurred in which illness has been caused in animals owing to samples of decorticated cake containing castor oil seeds.† These seeds may be present in consignments of nuts sent to Europe, but their presence is also possibly due to the cake being pressed on the same machines as castor oil seeds without the residues of the latter having been removed. A serious case of poisoning from this cause was reported in France in 1913,§ in which five cows aborted and one died through feeding on earth nut cake of the kind commonly used in France. A guarantee should be obtained from the vendor as to the absence of castor oil seeds from the cake.

Besides the possibility of spoilt and adulterated cakes, a third source of trouble in the past has been the presence of hairs on the cakes from the pressing cloths, though these hairs are usually easily visible on the outside of the cake.

Broken ground nut husks are frequently used to adulterate cakes and meals. The husks are also occasionally ground, mixed with molasses and used as a cattle food. The product

* Spoilt cakes were found to contain from 1·2 to 5·3 per cent. of sugar (reckoned on fat free organic matter); normal cakes from 6·2 to 9·1 per cent. Spoilt cakes contained from 0·3 to 0·5 per cent. of amide nitrogen; normal cakes not over 0·34 per cent. Spoilt cakes showed an average fat acidity of 75·3 per cent.; normal cakes 28·4 per cent. (*Bull. de l'Agric.*, 1906, No. 7).

† For a statement on the inclusion of castor oil seeds in cakes, see p. 359.

§ *Bull. Soc. Nat. d'Agri.*, 1913.

known in Germany as "ground nut bran" is generally a mixture of ground nut seed coats and husks.

Damaged and mouldy ground nut cake is used as a manure.

A leaflet giving statistical and commercial information regarding ground nuts can be obtained free on application to the Imperial Institute, and an article giving detailed information as to the cultivation, preparation, and uses of the nut will be found in the *Bulletin of the Imperial Institute* 1910, Vol. 8, No. 2 (London: Eyre and Spottiswoode, 1s. 2*d.* post free).

THE FAILURE OF A CROP OF BARLEY.

ARTHUR AMOS, M.A.,

School of Agriculture, Cambridge University.

THE following report is a record of the causes of failure of a crop of barley which were investigated by the writer as Agricultural Adviser of the Cambridge School of Agriculture.

Preliminary.—A letter was received from a Norfolk farmer stating that seed barley which he had purchased and sown on the greater part of a 20-acre field had failed to germinate, whilst home-grown barley, planted on the remainder of the field, had produced a satisfactory plant.

Enquiry from the grower of the purchased seed, who farmed in another part of Norfolk, showed that seed from the same sample had been sown upon three fields on the grower's farm and on several of his neighbours' fields with excellent results, and, further, that another portion of this sample had been sown upon a farm near the scene of the failure, and had produced a very good plant.

The affected barley field was examined on 11th May, when the following observations were made:—

Soil.—The soil upon which the barley was sown is a poor and very light blowing sand (called Breck Land in Norfolk), and is typical of a considerable breadth of land in Norfolk and Suffolk.

Previous Cropping and Treatment.—In 1914 this field had been cropped with mangolds, and as a result of the thorough cultivation of this crop the soil was left very loose in texture. The field had been ploughed during the winter, and after harrowing to produce a tilth the field had been seeded with the barley in March. At the time of seeding the soil was

very loose, and the coulters of the drill sank deeply into the soil in places.

The Seed.—The seed was described by the foreman as being a very good sample in appearance, and before planting it had been dressed in order to protect it from damage by game, which in this part of the country are very numerous. Only 8 pecks per acre were drilled in place of the customary 10 pecks because it was desired to make the seed run as far as possible. The same quantity of home-grown seed had been sown upon the remainder of the field.

Germination.—Enquiry elicited the facts that both the purchased and the home-grown seed germinated very slowly owing to cold and inclement weather, that the home-grown was always much the better plant, and that the purchased seed was always very thin, and rapidly lost plant after it was through the ground. In consequence of this the part originally sown with purchased seed was re-sown in April.

The Crop.—On 11th May the part of the field cropped with home-grown seed presented a uniform but very thin crop. The part cropped with purchased seed was a complete failure, only a few scattered plants remaining, though the second sowing had since germinated and produced a good plant.

Depth of Seed.—A number of plants and germinated seeds were dug up in various parts of the field. It was noticed that whilst the barley sown at the second sowing, in April, was buried at a uniform depth of 1 in. to 1½ in., the first-sown barley was very deeply sown and very irregular in depth, some seeds being found as low as 4 in. in the soil. It was further noticed that without exception all the grains dug up from the first sowing had germinated (a fact easily detected by the roots attached to the grain—see Nos. 1, 2 and 3 in the illustration), but in the vast majority of cases the primary stem had been eaten through by wireworms, a number of which were present in the soil. Of the plants which had survived, the greater part were from seeds which had been fortunate enough to be buried at a shallow depth.

Later in the day, by the courtesy of a neighbouring farmer, the writer was enabled to see another field sown with barley from the identical sample which had failed on the first field. This field, which had been sown at the same time of year on similar land to that bearing the affected crop, and on the same tilth, namely after mangolds, presented an almost perfect seeding. There were, however, three conditions which varied

These were :—(1) 10 pecks of seed per acre were sown instead of 8 pecks ;

(2) The soil was consolidated by rolling before seeding ; and consequently,

(3) The seed was sown to a uniform depth of from 2 to 2½ in.

In the illustration below, Nos. 1, 2 and 3 are seeds sown 3 in. to 4 in. deep, which have germinated and have then been eaten by wireworms ; Nos. 4 and 5 are plants which have grown from seeds sown 3 in. to 4 in. deep and have produced weakly plants ; No. 6 is a healthy and vigorous plant grown from seed sown only 1½ in. deep.

Conclusions.

From the facts already stated, it is obvious that no one factor can be given as the sole cause of the failure of the first barley crop. On the contrary, it would seem that a number of causes each contributed its share to the weakening and final destruction of the barley plants. These causes are as follows :—

(i.) ***Vitality of the Seed.***—It is obvious that, since the same

sample of seed has on several other fields produced satisfactory results, no great fault can be found with the seed; nevertheless, if the foreman's statement is correct that no more seed was sown on that part of the field cropped with the home-grown seed, then it is clear that the vitality or vigour of the home-grown seed was greater than that of the purchased sample.

(ii.) *Dressing of the Seed.*—The dressing of the seed with a tarry preparation for the purpose of keeping away birds, good practice though it is, does tend to retard germination to a very slight extent, as the writer has tested experimentally.

(iii.) *Weather.*—The weather following seeding was cold and not favourable to quick germination.

(iv.) *Looseness of the Seed-Bed.*—This factor contributed in no small way to the failure, since it was owing to this that the first seeding was buried so deeply in the soil; as a consequence of this (1) a very large portion of the reserve food stored in the barley grain had to be used up in forming the long primary stem necessary to reach the surface of the soil (see No. 5 in the illustration), and (2) the wireworms were enabled to move freely through the soil.

The looseness of the seed-bed can be easily overcome by thorough harrowing and rolling before the seed is sown, a practice which was adopted by the successful grower on similar land. On such light land, the importance of consolidating the soil immediately below the surface cannot be too strongly emphasised, not only for the sake of uniformity in depth of seeding, but also for the sake of forming a good foothold for the roots and supplying them with moisture.

(v.) *Wireworm.*—The three causes already mentioned had each helped to weaken and delay germination, consequently the wireworm in this open soil had an easy opportunity of killing the barley.

(vi.) *Quantity of Seed.*—The reduction in the quantity of seed sown, from the normal of 10 pecks to 8 pecks, was a very important factor in the failure. Wireworms do not damage the plants in proportion to the number of seeds sown. On the contrary the damage done by them is always most serious in a thinly-planted field, It is, therefore, quite conceivable, that had 10 pecks been originally sown, sufficient would have been left to have produced a successful crop.

It should be remembered that the secondary roots upon which the plant depends for its sustenance, are alway formed near the surface, hence deep sowing does not, as is so often supposed, necessarily encourage deep rooting or drought resistance.

THE HITCHIN BACON FACTORY.

J. W. WELSH.

THE Hitchin Bacon Factory owes its origin to a movement started by a number of farmers living in the neighbourhood of Bedford. These farmers considered that, as the dealers formed a kind of "ring," they did not receive the value for their pigs when sold in the local market that they might reasonably have expected if there had been free competition. After giving the matter some consideration a party of the most energetic and influential of the farmers paid a visit to Roscrea and other large bacon-curing establishments in the South of Ireland, and also to some of the English factories. In due course the farmers interested formed a committee. A promise was received that, if the farmers would subscribe £5,000 among themselves, arrangements would be made to supply any further capital required. The necessary amount was subscribed by some 220 farmers. At this stage, however, the Bedford members became less enthusiastic in their support of the project, and it was decided by some of the most enterprising of the Hitchin members to establish the factory in their own district. The building was accordingly erected at Hitchin and formally opened there on April 13th, 1913.

In the erection of the Hitchin factory the aim has been to combine simplicity of construction and ease of supervision with a liberal supply of light and good ventilation. Full effect has been given to this aim, and it may fairly be claimed that the factory is the finest of its kind in the country.

The factory is built of brick, laid throughout in cement. The main building has a frontage of red brick of 181 feet, a depth of 139 feet, and a height of 30 feet 6 inches. The engine-room and pig pens are behind and outside the main building, and the total length of the building is 257 feet.

The killing and curing operations are carried out on the ground floor, the curing rooms being strongly insulated against outside temperature. The temperature of the chilling and curing rooms is maintained at 38° F. and 42° F., respectively, by the use of a 6-ton refrigerator plant.

In the following notes an attempt is made to give an impression of the routine work of the factory:—

Purchase of Pigs—A postcard giving the price of pigs for the following week is posted every Saturday to all the known pig keepers within a radius of 50 to 70 miles of the factory. Pig keepers are invited to send their pigs either by rail or by cart

on Mondays, Tuesdays, Wednesdays or Thursdays. When pigs are sent by rail the factory pays carriage on 10 pigs or over up to 100 miles, but if the farmer carts the pigs himself he has to deliver them free.

As the shareholders have not been able to supply the requisite numbers of animals, a proportion of the pigs are bought from pig keepers who are not shareholders and, when necessary, from dealers.

All pigs bought are paid for by dead weight, the factory paying for the whole carcass with the exception of the intestines and pluck.

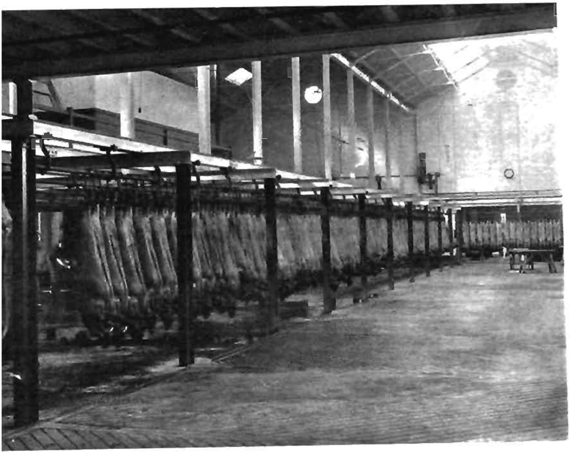
Treatment in Factory.—After the pigs have been delivered they are put into numbered pens, and each lot is earmarked with a number. This number is communicated to the owner to enable him to distinguish his own pigs if he comes to see them weighed.

The pigs are held over for one night to allow them to rest and empty their stomachs as much as possible, and are killed the following morning.

From the commencement all pigs have been killed with the R.S.P.C.A. humane killer, or captive bolt pistol, which has proved very efficient, and although adding to the cost of the killing it is considered a great advance on the old and less humane system of bleeding to death. After the pigs have been shot they are hoisted by a shackle attached to the hind leg, which is hooked to an endless chain. The pigs are carried along by the chain and deposited on a running rail which conveys them to the bleeding passage. They are there bled, the blood running into a tank, where it is dried each day and eventually used as manure. The carcass is then conveyed to the scalding tank where it is scalded at a temperature of 150° F. At this stage the hair is scraped from the carcass, collected and dried, and afterwards sold for stuffing saddlery, etc.

The pig is then drawn on the running rail to the singeing furnace. This consists of a cylinder containing a number of gas jets, through which mixed air and gas are forced with a powerful fan, thereby forming a series of strong Bunsen burners which give off an intense heat.

The pig is subjected to the heat of this furnace for 30 to 40 seconds. The heat exerts a contracting influence on the skin, effacing wrinkles, and giving the carcass a plumper appearance. It also imparts the nutty flavour peculiar to the Wiltshire style of curing. After leaving the furnace the pig is lowered into a cold bath and cooled off, and any burnt skin is removed. The pig is then opened up and disembowelled near a table



—Hanging Floor. Length 130 ft. Showing 120 carcasses of pigs killed the day before the photograph was taken.

2.—Sausage, Pie-making, and Lard Refining Departments. Length 139 ft., width 35 ft.

at which a number of women are ready to clean the intestines and similar organs. Parts of the intestines, when prepared, are used for sausage casings, the stomach and other parts for chitterlings, the fat is rendered for dripping, and the bladder filled with lard.

When the dressing has been completed the carcasses are conveyed to the weighing scales. Weighing takes place at 12 o'clock noon, and the owners of pigs are invited to be present and see their own pigs weighed. A beam-scale is provided for the weighing. This picks the carcass off the rail, weighs it, and replaces it on the rail.

All pigs are bought by the score of lb., so that the farmers can check the weights with greater ease. The weights used are 50 lb., 20 lb., 10 lb., 5 lb., and a number of smaller weights. After the pigs are checked and weighed the carcasses are split into halves, the back bones and flake lard are taken out, and the heads are cut off. The sides are then put in the chilling-room, at a temperature of 38° F., until the following morning, when they are trimmed up by having the blade bone extracted, part of the ham bone taken out, and th loin steaks, skirts, and any other ragged pieces removed. After having once more been placed in the chill room for 24 hours the loin steaks are sent to the pie department, and the skirts and trimmings to the sausage room for making saveloys, polonies, etc.

After the sides have been chilled for from 36 to 40 hours they are dry-salted. The first part of the process is to inject a pickle of salt and saltpetre (no other chemicals are used) by the aid of a pump. To ensure uniformity in curing, the pickle is first injected into the thick parts, *i.e.*, fore-end and gammon. The sides are then piled on top of each other, 10 sides high, in the curing room, at a temperature of from 40° F. to 44° F. As each side is placed on the top of the one below, it is lightly dusted with fine saltpetre and a thin layer of curing salt. The sides are left in the pile for nine or ten days, according to their weight. At the end of this period they are taken from the pile and the pickle is drained off, after which they are again piled up, this time with the skin uppermost, to drain, dry, and mature for another ten days. The sides are then ready for use as green bacon, or for smoking.

If smoked bacon is required, the sides are washed and dusted over with pea flour, hung in the smoke houses and smoked and dried with hard wood sawdust for from three to four days, according to the weather. In wet weather the drying takes longer. The heads are used for making brawn, and the chaps and fe

The pie product department of a bacon factory is an important one. In the Hitchin factory heavy fat sows and pigs are largely killed for making sausages, pies, brawn, galantines, polonies, saveloys, faggots, etc. The whole carcass is used for the purpose, and in this way a profitable outlet is found for this class of pig.

Lard making is also a considerable industry. As soon as the flake is taken from the pig it is cooled off, and then put through a crushing machine to crush up the small globules and release the liquid fat more easily. The fat falls from the crushing machine into a small jacketed pan where it is melted and boiled to evaporate any natural moisture. After this it is run into a settling pan where it is allowed to stand for about six hours to allow any fibrous particles to settle to the bottom of the pan. It is then pumped into an agitator—a jacketed vessel with revolving paddles—where it is beaten up to get texture. It is then drawn off while in a semi-liquid state into the different types of packages in which it is to be stored, *e.g.*, bladders, parchment bags, tins, etc.

Type of Pig Required.—One of the first difficulties encountered in establishing new bacon factories is to obtain locally pigs which produce bacon suited to the public taste. The pig required for a Wiltshire side should have a small shoulder (as this is the coarsest part, and in retailing realises the least money), a good deep middle, with a good loin and a good ham, and not too great a thickness of fat on the back. Top prices are usually paid for pigs weighing from 120 to 190 lb. dead weight.

The Large White most nearly fulfils these requirements, although some strains of this breed have to be fed over the weight quoted to get them properly finished. Some strains of Middle White also make very useful pigs, but one of the best bacon pigs is obtained by crossing a Large Black sow with a Large White boar, although almost any good sow will produce a good bacon pig when put to a pure-bred Large White boar.

Support of Farmers.—Unfortunately the success of the factory as a co-operative institution has been somewhat impaired by the failure of the members to support it loyally. The farmers show a marked disinclination to bind themselves to send all their pigs to the factory, and still often sell to local dealers whenever the price offered is higher than that offered by the factory. They fail to realise that their loyal support would increase the dividends and apparently forget that they have invested their capital in the factory. It should be pointed out, moreover, that

the competition of the factory has been instrumental in raising the local prices by from 5 to $7\frac{1}{2}$ per cent., and that were this competition withdrawn, owing to the failure of the factory, the prices obtained might be considerably less than they now are.

Some difficulty has also been experienced in the endeavour to induce the members to study the requirements of the factory in breeding the right type of pig, and in feeding to produce the best bacon.

Results Obtained by the Factory.—The factory commenced working at a rather unfortunate time. The price of pigs was at first abnormally high, and with a run of falling markets a considerable sum of money was lost during the first 10 months' trading. During the following six months, however, matters greatly improved, and after paying all charges this period showed a satisfactory profit. The sum of £42,486 was spent in the purchase of pigs in the first 10 months, while the total amount thus expended during the first full year's working was £59,415.

The speed with which the factory established itself is well shown by the fact that in the fifth month of its existence the goods sold amounted to £7,225 16*s.* 8*d.* The winning of the Empire Trophy at the Dairy Show has undoubtedly stimulated the growth of business. The Company has also since taken 1st, 2nd, and 3rd prizes at the Royal Agricultural Show at Shrewsbury.

Capital Required.—As other co-operative bacon factories are likely to be established in other parts of the country in the course of the next few years it may be of interest to give the experience of the Hitchin factory as regards the raising of the necessary capital and the cost of working. It was found impossible to raise in the district itself more than about half the capital required, or only sufficient to build the factory. To finance the trading part of the business, capital had to be borrowed from other sources. A large amount of trading capital is required to tide over the business until the first returns come in. The processes of curing and smoking take from three to four weeks, and a further period of six weeks must be allowed before payment can be obtained from the retailer. As it is the practice to pay the farmer in cash it will be seen, therefore, that to deal with 300 pigs a week costing, say, on an average, £4 each, a working capital of about £12,000 will be required. To start a modern bacon factory on even a moderate scale it will be necessary to raise at least £20,000.

NOTES ON FEEDING STUFFS IN JULY.

From the Animal Nutrition Institute, Cambridge University.

THE feeding stuffs included in the following notes are the same as those mentioned in former notes,* and the method of calculation is the same as that already described. The large table, p. 323, gives the price per ton and per food unit† of about 30 feeding stuffs at London, Liverpool, Hull and Bristol on 28th June. These feeding stuffs are arranged in the list, p. 324, in order of the average price per food unit at the four markets.

As before, there is a certain amount of variation in the price of certain articles at the different markets, due no doubt to varying cost of transport from the centre of production or the port of landing. This variation, however, is not in most cases so great as to invalidate the average figures. The figures as a whole show that prices have fallen slightly, and this fall is specially noteworthy in wheat offals, which have no doubt been influenced by the fall in the price of wheat. Undecorticated cotton cake, both Egyptian and Bombay, is one of the few foods which have risen in price. It is now appreciably dearer per food unit than linseed cake, and at present prices it is not an economical food to buy. Maize and its products and rice meal are cheaper than last month. Oats and barley are still far too dear to use except in case of necessity.

Suggestions for Rations in July.

For Farm Horses at Work.—At this time of year work is often slack, and the horses are allowed to graze with little or no added dry food. This is not a good preparation for the hard work of the harvest. It will usually pay to give them some such ration as that suggested last month.

For Milking Cows.—Heavy milkers are very liable to fall off in their yield of milk towards the end of July or the beginning of August, especially when drought has cut short the supply of grass, as is the case this year. To prevent this they should be given a liberal supply of green stuff from the arable land where this is available. Otherwise they should be given in their mangers a mixture of two parts maize gluten feed, one part linseed cake and one part rice meal. Four or five

* This *Journal*, March, 1915, p. 1111; April, 1915, p. 52; May, 1915, p. 148, and June 1915, p. 248.

† This *Journal*, May, 1915, p. 148.

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate prices per ton at the beginning of July.				Approximate prices per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya Bean Cake	1 : 1·1	122·3	8 0 0	8 7 6	8 2 6	8 2 6	1 3¾	1 4½	1 4	1 4
Decorticated Cotton Cake	1 : 1·3	126·3	9 0 0	10 5 0	—	9 15 0	1 5	1 7½	—	1 6½
Indian Linseed Cake	1 : 1·9	123·1	—	9 15 0	9 15 0	—	—	1 7	1 7	—
English Linseed Cake	1 : 2·0	120·1	10 7 6	10 15 0	9 15 0	10 7 6	1 8¾	1 9½	1 7½	1 8¾
Bombay Cotton Cake	1 : 2·4	65·3	—	6 15 0	6 12 6	6 17 6	—	2 1	2 0½	2 1¼
Egyptian Cotton Cake	1 : 2·0	71·9	6 12 6	7 10 0	6 17 6	7 2 6	1 10½	2 1	1 11	2 0
Coconut Cake	1 : 3·8	102·6	6 17 6	—	—	8 0 0	1 4	—	—	1 6¾
Palm-nut Kernel Cake	1 : 4·0	83·5	5 13 9	5 5 0	—	7 0 0	1 4¼	1 3	—	1 8¼
English Beans { New Spring Old Spring Old Tick	1 : 2·6	99·5	9 0 0 9 10 0 10 10 0	10 10 0	9 11 0	9 9 6	1 9¾ 1 11 2 1½	2 1½	1 11¼	1 10¾
Chinese Beans	1 : 2·6	101·2	9 15 0	10 10 0	9 6 6	—	1 11¼	2 1	1 10	—
English Maple Peas	1 : 3·2	97·2	11 2 0	—	10 0 0	—	2 3½	—	2 0¾	—
English Dun Peas	1 : 3·2	97·2	10 0 0	—	9 16 0	—	2 0¾	—	2 0¼	—
Calcutta White Peas	1 : 2·3	97·5	13 6 6	14 0 0	—	—	2 8¾	2 10¼	—	—
American Maize	1 : 11	93·8	8 3 6	8 17 6	—	—	1 9	1 10¾	—	—
Argentine Maize	1 : 11	94·2	7 9 6	8 13 6	7 14 0 8 0 0	8 3 6	1 7	1 10¼	1 7½ 1 8½	1 9
Maize Meal	1 : 13	86·5	8 10 0	8 10 0	9 2 6	8 5 0	1 11½	1 11½	2 1¼	1 11
Maize Gluten Feed	1 : 3·3	121·6	8 0 0	—	—	8 7 6	1 4	—	—	1 4¼
Maize Germ Meal	1 : 8·4	99·2	8 3 9	9 0 0	8 17 6	8 10 0	1 8	1 9¼	1 9½	1 8½
English Feeding Barley	1 : 7·8	83·0	10 1 6	10 5 6	9 16 0	9 16 0	2 5¼	2 5¾	2 4¼	2 4¼
English Oats	1 : 7·9	75·4	12 0 0	11 16 6	11 0 0	12 0 0	3 2¼	3 1½	2 11½	3 2¼
Argentine Oats (Buenos Ayres) .. Argentine Oats (Bahia Blanca) ..	1 : 7·9 1 : 7·9	75·4 75·4	9 19 0 10 6 6	10 11 3	10 13 6	10 6 6	2 8 2 9	2 9¾	2 10¼	2 9
Malt Culms { London .. .. Burton mixed ..	1 : 3·6	69·9	5 15 0 5 3 9	6 7 6	5 0 0	6 0 0	1 8 1 5¾	1 10	1 5¼	1 8¾
Brewers' Grains (dried)	1 : 3·4	84·5	5 16 3 *5 18 9	—	6 10 0	6 10 0	1 4½ 1 5	—	1 6½	1 6½
Brewers' Grains (wet) { mixed finest ale ..	1 : 3·4	21·1	14 6 16 0	—	1 4 0	—	0 8½ 0 9	—	1 1¾	—
Egyptian Rice Meal	1 : 10·3	78·7	—	—	—	—	—	—	—	—
Burmese Rice Meal	1 : 10·3	78·7	6 5 0	6 10 0	—	7 5 0	1 7	1 8	—	1 10
Wheat Middlings	1 : 5·3	93·4	7 7 6	—	7 5 0	—	1 7	—	1 6½	—
Wheat Sharps	1 : 5·3	86·3	7 5 0	8 7 6	8 5 0	7 15 0	1 8¼	1 11¼	1 11	1 9¼
Wheat Pollards	1 : 5·3	81·9	—	6 0 0	—	—	—	1 5¾	—	—
Wheat Bran	1 : 5·3	77·5	5 15 0	5 17 6	6 0 0	5 12 6	1 6	1 6	1 6¼	1 5½
Wheat Bran (broad)	1 : 4·7	79·9	6 17 6	6 10 0	7 5 0	6 2 6	1 8¾	1 7½	1 10	1 6½

* Fine Ale Grains.

pounds of this mixture per head per day is the ration for a cow yielding 2½ to 3 gals. of milk per day. This must be increased for cows giving higher yields. Another mixture which may be used for the same purpose is equal quantities of linseed cake and pollards. These mixtures must be given in the manger. They are liable to get wet and pasty if put in tubs in the field, in which case the cows do not eat them readily. For use in tubs in the field, equal quantities of linseed cake and coconut cake may be used. Cows do not take to coconut cake at first, so it should be introduced gradually, the first few days a very little being added to the linseed cake, and the proportion increased until it is half and half. Given in this way cows eat it well. At present prices it is a cheap food and suitable for milking cows.

Average Prices per Food Unit at the Four Markets of the 30 Feeding Stuffs, shown on page 323.

	s.	d.		
Brewers' grains (wet)	0	11½	per food	unit.
Soya bean cake	1	4	,,	,,
Maize gluten feed	1	4¼	,,	,,
Palm-nut kernel cake	1	5¼	,,	,,
Coconut cake	1	5½	,,	,,
Wheat pollards	1	5½	,,	,,
Brewers' grains (dried)	1	6	,,	,,
Wheat bran	1	6	,,	,,
Decorticated cotton cake	1	6¼	,,	,,
Wheat middlings	1	6¾	,,	,,
Linseed cake, Indian	1	7	,,	,,
Malt culms	1	8	,,	,,
Wheat bran (broad)	1	8	,,	,,
Rice meal, Burmese	1	8¼	,,	,,
Maize, Argentine	1	8¼	,,	,,
Linseed cake, English	1	8¾	,,	,,
Maize germ meal	1	9	,,	,,
Wheat Sharps	1	9½	,,	,,
Maize, American	1	9¾	,,	,,
Beans, Chinese	1	11¼	,,	,,
Beans, English	1	11½	,,	,,
Cotton cake, Egyptian	1	11½	,,	,,
Maize meal	1	11¾	,,	,,
Peas, English dun	2	0½	,,	,,
Cotton cake, Bombay	2	0¾	,,	,,
Maple peas, English	2	2	,,	,,
Feeding barley, English	2	5	,,	,,
Oats, Argentine	2	9	,,	,,
White peas, Calcutta	2	9½	,,	,,
Oats, English	3	1¼	,,	,,

For Baby Beef at Grass.—At the present price of beef it is desirable to bring on young stock intended for baby beef as quickly as possible, and liberal feeding is desirable. The follow-

ing ration is recommended, which is suitable for young stock about 4 months old, and should be gradually increased to double this amount by the time they are 10 months old :—

1 lb. linseed cake,
1 ,, bran,
1 ,, crushed maize,

To be given dry with about a pound of hay chop.

For Heifer Calves and Store Steers at Grass.—Where grass is short the following ration may be used :—

½ lb. linseed cake,
1 ,, bran,
1 ,, dried grains,

To be given dry mixed with about a pound of hay chop.

For Lambs to come out as Mutton in the Autumn.—The following mixture is suitable for lambs on tares or clover aftermath :—equal quantities of linseed cake, dried grains, rice meal and crushed maize. The ration should vary from ¼ lb. to 1 lb. per head per day, according to the age and weight of the lambs.

For lambs on cabbage, early turnips, rape or mustard the mixture should be equal quantities of linseed cake, dried grains, rice meal and bean meal, and the ration should vary as before with the size of the lambs.

For Pigs.—Stores 7 months old and over to come out in the autumn as large pork pigs (cutters) :—

A mixture of 7 parts of sharps and 1 part of linseed cake; ration according to age and weight. The linseed cake should be broken fine and not added to the slop until immediately before feeding. Some samples of linseed cake are liable to develop poisons if kept wet and warm for any considerable time, for instance, two or three hours.

Other pigs as in former notes.

COMBINATION IN POULTRY KEEPING.

EDWARD BROWN, F.L.S.

THE smaller a holding the greater, *pro rata*, is the number of poultry usually kept. That is true in England and Wales as in all other countries. Table 12 of the Poultry Census of 1908 reveals the variations, which are very suggestive. For agricultural holdings exceeding 1 acre in Great Britain (England and Wales were not separately enumerated in that report) the fact is stated in a striking manner. This table includes both old and young birds. The following are the total numbers of fowls (excluding ducks, geese and turkeys) :—

Holdings above 1 acre and not exceeding 5 acres	940 fowls per 100 acres.
" " 5 acres " " 50 "	244 " "
" " 50 " " " 300 "	77 " "
" " 300 "	37 " "
Total	100 " "

Out of each 100 fowls recorded the adults numbered 53 and the young stock 47. It will be seen, therefore, that for every fowl on farms above 300 acres in extent there were 25 on those above 1 acre and not exceeding 5 acres for the same acreage of cultivated land.

The Question of Labour.—To a considerable extent these variations are due to the fact that many of the larger farms are either arable or that they are used for stock rearing. On farms of the former type fowls are not regarded with favour, while on the latter the necessity for regular attention and housing of poultry has hindered increase. Moreover, many areas are comparatively thinly populated, consequently labour is often not available for control and oversight. At the same time much more ought to be done than is now the case though, as a question of economics, it cannot be expected that the same average production of eggs and poultry will ever be attained on large as on small farms.

One of the main difficulties met with by larger farmers who are disposed to develop a poultry branch of their operations is that they are unable to attend to the fowls themselves, and think they cannot find trustworthy men to do so. This is not a question of fixed hours. Hens require to be attended to early and late and often. Poultry-keeping is a personal industry, succeeding best where the operators have a realisable

interest in the financial results. The numbers of poultry kept are, therefore, frequently restricted to the capacity of the farmer's family.

A Method of Co-operation.—A system has been evolved within the last generation in the semi-agricultural, semi-industrial areas of East Lancashire and the West Riding of Yorkshire, though not unknown elsewhere, by which those in occupation of the land and those desirous of keeping fowls act in unison. In these districts the land is chiefly used for milk production or grazing. Many of the farms are moderate in size so that the labour provided by the farmer's family has to be entirely depended upon. In not a few cases delivery of milk and other work does not leave much margin of time. Poultry-keeping has not developed to the extent that might be expected among this class of farmers. On the other hand, artisans residing in the manufacturing villages in those northern valleys have for generations been ardent breeders of poultry. At one time they were mainly fanciers and exhibitors, and their little plots sufficed for their needs. With the growth of utility poultry-breeding more land became imperative for the development of the industry. Provision of allotments has done much to increase the opportunities for keeping poultry, as has also the system of co-operation already referred to, the advantages of which are: (1) that the poultry-keeper does not require to be also a farmer and has no responsibility for cultivation of the land; (2) that he is thus enabled to keep a much larger stock of fowls than would be possible on a small plot, avoiding all danger of tainted soil and minimising risks of disease; (3) that the cost of equipment is much reduced, as wire netting is not required; (4) that the cost of feeding is less as the birds obtain a fair amount of natural food; (5) that the farmer, without assuming responsibility for the birds or labour in management, receives a rent for the use of his land, in addition to which the pastures are benefited by the manure produced.

This system is capable of considerable extension in all pasture areas and to a less extent upon arable lands, not alone where industrial operatives reside but also for farm labourers and other rural residents. Its adoption would largely increase home production, to the benefit of both parties to the arrangement.

How the System Works.—The conditions under which this method is carried out are clearly defined. The farmer gives access to his fields either at all or at stated times, so that the poultry-keeper may attend to his fowls. He imposes a limit

as to the number of birds, and has the right to say when and to where the houses must be moved. Upon pastures such removal is essential. If the fowls were allowed to remain too long in one place the herbage around the houses would be injured or destroyed, and the full benefit of the manure would not be obtained owing to incomplete distribution. On arable fields one corner might be allotted, where the ground would be left bare. This would, however, necessitate a loss of crop, so that it is preferable, and, as a rule, possible to alternate between fields in accordance with the rotation of crops. Cattle can be kept on the same fields as the poultry so long as there is no overstocking.

For this method of poultry-keeping portable houses should always be employed. They ensure that mobility which is essential to successful conduct of the system. The number of birds which can be allowed will vary in accordance with existing conditions. In the case of a labourer engaged upon a farm it might be felt desirable to impose restrictions so that there would be no danger of his neglecting his regular duties. Probably one house with twenty-five hens would be regarded as the limit. In the case of other persons there need be no curtailment in this way. All that has to be considered is the number of fowls that can be maintained on the land without risk of interference with the other operations of the farm. On a pasture field wherein are other stock ten birds to the acre over which they run will be enough. Where the land is laid down for hay as many as twenty-five fowls per acre will not be too many. In that case they would be removed ten weeks before cutting takes place.

It is wise to insist that the poultry-keeper shall hatch and rear chickens upon a plot near his residence, not putting out the birds until they have made sufficient growth to look after themselves, and do not require constant feeding. That is, however, an arrangement which can be left for determination in each individual case. In one instance a cottage was let to the poultry-keeper with an acre of land, upon which all the chickens were reared. The breeding and laying stock and growing chickens were allowed to run on the farm in the manner stated.

Where it is intended to carry out such a system as that advocated by Mr. F. G. Paynter,* the breeding stock could be kept on the open fields to which the poultry-keeper would be allowed

* See this Journal for June, 1914, p. 220.

access, while hatching and rearing to the killing stage could be conducted upon an allotment devoted to that purpose, in which case provision would be indispensable for change and cultivation of ground at least once a year. In this way the vigour of the parent stock and, therefore, of the chickens would be maintained.

The method described above is one which opens out a wide field of effort and enterprise for women as well as men, and would give a great stimulus to home production, improving the position of rural workers. A further point is that in many cases it would be a profitable supplement to other sources of income.

The charge usually made for permission to place a house on the land in the manner described, is 6*d*. per bird per annum, or 10*s*. per house yearly with not more than 25 adult fowls or 40 growing chickens, or for the latter 1*s*. per calendar month might be charged. As already stated, the farmer has the benefit of the manure, which for 25 fowls would be equal in fertilising value to 25*s*. to 30*s*. per annum, in accordance with their size and breed. Thus he stands to gain very considerably.

A Belgian Method.—Upon an estate at Lippeloo, in East Flanders, a plan (suspended for the present as a result of war conditions) has been in operation for some years which would possibly be preferred by landowners and larger farmers, so far as their own men are concerned, where they are willing to organise and supervise the operations. A considerable number of pullets are hatched every year. In the autumn about 600 are selected for breeding purposes, and, with the necessary males, are loaned to farmers and cottagers on the estate according to the accommodation available. The birds remain the property of the landlord, who has the right to remove them and replace them the following autumn. Each of the recipients manages the flock committed to him and provides the food at his own expense. All the eggs laid are sent to a centre twice a week. The payments are made at fixed rates, so that the individuals have no responsibility for finding markets. As the birds are at full liberty they find the greater part of their food and are inexpensive to maintain. It is stated that the profits in many instances amount to 6*s*. per hen per annum. The return, however, is largely dependent upon efficient and careful management, which in itself is a stimulus to those undertaking the work. Many an agricultural labourer with the help of his wife, and many older people who

live wholly or partly upon charity, could in this manner make an appreciable addition to their small incomes, if the opportunity were afforded. It is a form of combination or co-operation which would greatly increase the native supplies of eggs and poultry.

Conclusions.—The two methods referred to above are not suited to small farms or holdings, but to the larger farms. It is upon these that the great development of egg and poultry production must take place if the country is to attain its full capacity. In England and Wales 68 per cent. of the land under cultivation is in farms of more than 100 acres. Upon the fruit orchards of the country there is a vast opportunity for extension of poultry-keeping, as these have hitherto been used only to a very limited extent. The system referred to above could be adopted with advantage in many cases. If the power of organisation of these classes of agriculturists were employed to develop the poultry industry on the lines referred to, the nation would be independent of foreign supplies, and the humbler workers would be able to turn their spare time and the labour of their families to profitable use.

EGG PRODUCTION AT MORDEN HALL, 1914-15.*

Introduction.—In view of the fact that at the present time many poultry keepers are reluctant to increase their stock of birds, and in many cases have reduced their normal flocks owing to the enhanced price of feeding stuffs, it may be of interest to give an account of the results obtained from a number of pullets which were raised last year at Morden Hall as table birds, but on the outbreak of war were retained for laying purposes.

Character of Stock.—In August, 1914, there were about 1,200 pullets among the table chickens at Morden Hall, the remainder of the stock being cockerels. As the birds were sold off in weekly batches when they reached the age of 12 to 14 weeks, none of these pullets were hatched prior to 1st May, 1914, and the greater number of them were hatched subsequent to the middle of May. A fairly large proportion were pure-bred birds of the following breeds or varieties :—Light and Speckled Sussex, Faverolles, White Wyandotte, White and Buff Orpington, and Rhode Island Red. In addition, there were some first crosses and a few mongrels.

Although these birds were not in any sense promising for egg production, as they were hatched late in the spring, and were largely of the table or general purposes type, having been reared with a view to the production of flesh, it was felt that they nevertheless constituted the potential source of a very considerable egg supply. In the middle of August, therefore, it was decided to make a selection of the birds and to retain about 1,000 pullets for egg production.

Method of Housing.—The first consideration was the manner in which the birds were to be housed. The laying section was not intended to be a permanent feature of the Morden Hall demonstration, and the object in establishing it temporarily was to meet an emergency. It was, therefore, important to house the birds cheaply. Despite some adverse criticism, Mr. Paynter decided to use Sussex arks for the pullets, each ark costing *27s. 6d.*, and accommodating 25 birds. Separate nest boxes were provided which were placed beside the arks. The runs averaged 30 yd. by 9 yd., and were erected on a

* An account of the Chicken Rearing Demonstration at Morden Hall in 1913–14 was given in this *Journal* for April, 1915, p. 10.

fresh piece of light, dry grass land, where a certain amount of protection from wind was afforded by a hedge.

The runs were constructed of wire netting and chestnut or hazel posts, which cost about $\frac{3}{4}$*d.* each. They were arranged on the four sides of a rough rectangle with paths which gave facilities for feeding and the collection of eggs. No gates were used, and access was gained to the runs by placing one movable post, which was loosely fixed in the ground, next to a fixed post and attached to it at the top by a stout wire ring which could be slipped over the top of the post at will. When the ring was removed an entrance was obtained between the two posts. The forty runs necessary to accommodate the pullets were erected by Mr. Paynter and an assistant without any further help, and they were completed for the reception of the pullets early in October, 1914. The arks were placed in them, and in order to prevent the ground below the house becoming foul, and to preserve part of the manure, a board with slightly sloping sides was fitted below the slatted bottom of each ark.

The total cost of providing 40 houses, nest boxes, dropping boards, water and grit pans, food tins and the wire netting and posts, including sundries, amounted to about £120 11*s.* 4*d.* The cost of housing was, therefore, about 2*s.* 5*d.* per bird.

One thousand and sixteen pullets were selected, and the laying stock was divided into flocks of 25, each of which was placed in a separate run. Of the pullets originally selected 61 were subsequently killed for consumption, and a few deaths occurred from ovarian troubles during the period up to 31st May, so that at that time there were about 950 birds in the runs.

Method of Feeding.—The birds were fed in the morning with a mash prepared as follows :—

Meat Meal	1 lb.
Biscuit Meal	1 lb. 10 oz.
Bran	1 lb. 10 oz.

mixed with $1\frac{1}{2}$ gal. of boiling water and dried off with 8 lb. of sharps.

In the evening they received a grain mixture made up as follows :—

Wheat	2 parts.
Maize	1 part.
Oats	1 part.

They were supplied with ample quantities of grit and oyster shell, and with clean water. No green food other than that obtainable on the runs was given to the birds.

The eggs were collected mainly in the afternoon, but additional collections were made as the yield increased.

The houses and nest boxes were regularly cleaned and the runs were occasionally swept, but the management, while systematic and careful, did not provide for any coddling.

Marketing.—The eggs were weighed and counted, and any exceptionally small or ill-formed specimens were removed, the remainder being despatched to London and sold on commission through a large wholesale firm. The eggs were always despatched *within* 24 *hours* of the date of laying.

Approximate Financial Result after 8 Months' Work.—The following table gives a statement of the results which were obtained up to 31st May, 1915:—

Morden Hall Egg-laying Demonstration, 1914–1915.

Month.	No. of Eggs marketed.	Cost of Pullets' Food. (Approx.)			Gross Proceeds of Sales. (Approx.)			Railway Charges and Commission. (Approx.)			Net Proceeds of Sales. (Approx.)		
1914.		£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
October ..	1,131	35	0	0	7	11	0		—		7	11	0
November ..	2,138	30	17	2	19	1	0		16	5	18	4	7
December ..	5,230	31	13	1	48	7	11	3	6	11	45	1	0
1915.													
January ..	9,360	32	13	10	72	4	3	6	0	8	66	3	7
February ..	10,365	32	18	5	72	0	7	6	9	0	65	11	7
March ..	15,443	42	13	6	82	5	11	7	19	10	74	6	1
April	14,736	40	16	9	73	6	4	7	11	7	65	14	9
May	12,394	37	19	6	64	11	0	6	13	10	57	17	2
Totals ..	70,797	284	12	3	439	8	0	38	18	3	400	9	9

Consideration of the Returns.—Taking the average number of pullets on the runs during the period as 1,000 it will be seen that the egg yield from 1st October, 1914, to 31st May, 1915, was over 70 eggs per bird, and the average gross price received for the eggs was approximately 1*s.* 6*d.* per dozen, while the cost of food per pullet during the period was 5*s.* 8¼*d.* Each pullet, therefore, cost 2*s.* 5*d.* to house and 5*s.* 8¼*d.* to feed, and produced in eggs a gross amount of 8*s.* 9½*d.* The net proceeds of the sales show a profit over the cost of food of £115 17*s.* 6*d.*, or about 2*s.* 3¾*d.* per bird.

These figures are interesting in connection with the production of eggs under present conditions.

The statement given does not pretend to represent a complete profit and loss account, but affords some useful information.

It is clear, for example, that present food prices do not make egg production unprofitable. The ration fed at Morden Hall was not a cheap ration, the ingredients were all of good quality, and *all of them save the water had to be purchased.*

In regard to housing, the results are even more interesting. Mr. Paynter received little encouragement when he proposed to house pullets for egg production in Sussex arks through the winter with no other means of shelter. It was predicted that the results would be anything but satisfactory. The past winter and spring have been characterised by heavy and continuous rains, and by cold winds, and these conditions were calculated to test this method of housing severely. The results indicate that, in the climate of the southern half of England, houses of the Sussex ark type have a wide sphere of usefulness, in addition to the marked advantages of mobility and cheapness.

When the cost of housing these birds is compared with the cost under other systems involving enclosed runs, it will be found both inexpensive and possessed of great advantages in the ease with which the equipment can be moved to fresh ground and re-erected. More expensive housing may tend to increase the egg yield, but the commercial poultry keeper must consider how far the additional outlay tends to increase his actual profit.

In considering these results it is necessary to remember that the records cover 8 months only, and include the most productive period of the year, and that the ground was very heavily stocked (at the rate of nearly 500 birds to the acre), so that the same runs could not safely be used for another year. This would involve a change of ground, and the labour of removing the equipment to a fresh site if a similar stock were retained for laying in 1915–1916.

THE BREEDING OF UTILITY PIGEONS.

A. A. GOODALL.

UNTIL recent years the supply of table pigeons for the English market was practically dependent upon imports from various continental countries, Italy being by far the largest producer of the so-called " Bordeaux " pigeons—long generally recognised as the best type of utility bird. France and Belgium have also each contributed in no small measure to the nation's supply, but imports from the former country have steadily decreased, and those from Belgium are at present nil.

On the other hand, English breeders have, during the last decade, given considerable attention to the improvement of table pigeons, both by the importation of carefully selected stock,. and strict attention to mating, with a view to the production of a market bird of all-round excellence. As a result there are now very many British lofts devoted exclusively to the rearing of table pigeons on commercial lines, and satisfactory progress is generally reported. The industry is still young, but the prospects are good, and in view of the steady and growing demand for first-class table " squabs," by which name the marketable birds are known, and of the fact that very little space is required to breed them successfully, the small-holder may with advantage include a small flock of pigeons as a side-line.

Young pigeons, when killed, can be disposed of either locally or in the various London markets, where the best type of " Bordeaux " birds are sold retail at prices often reaching 2*s*. 6*d*. per bird, and even more, when the season is at its height.

There is also a ready sale for young birds required for stock purposes, and many breeders rear birds exclusively to supply this demand, realising remunerative prices for stock of the approved type.

In rearing pigeons for the table it is important to remember that the breeder should only keep very prolific birds, and those capable of producing large, fast-growing squabs, fine in bone and possessing a delicate, white skin.

The best Breeds.—Many kinds of pigeons are reared for table purposes, including common Homers, but the two most suitable are the Carneau and the Mondain, the latter a recognised type of the French Gros Mondain, probably evolved by a series of out-crosses with other allied breeds.

Of the two, the Carneau is perhaps the more prolific and somewhat hardier pigeon, though both are quick breeders and easily kept, even in exposed positions. They are now well established in this country, and readily procurable.

The *Carneau* is a large-sized pigeon, weighing, when adult, from $1\frac{1}{2}$ to 2 lb. It is a native of Flanders, where for generations it has been bred almost exclusively for utility purposes, gaining a reputation second to none as a producer of the best class of table squabs. In colour the birds are either red or yellow, mottled with white, but those most frequently met with in England are wholly red, no particular attention being paid by utility breeders to colour or markings. Small, undersized specimens are frequently offered for sale, but should be avoided, hens especially, such birds being wanting in stamina and unlikely to produce robust stock.

In build the Carneau is a thick-set, compact pigeon, possessing a broad, meaty breast, and a pinky-white skin. It is somewhat short in neck, and, unlike many of the large breeds, is not overburdened with great length of feather in the wings—a decided consideration in the utility loft, where freedom of action and absence of clumsiness are of supreme importance. The legs are pale-red in colour and without feathering, and this, coupled with the fact that the Carneau is active in habit and light upon the wing, renders it an eminently attractive-looking and decidedly ornamental pigeon.

It is also tender with its young whilst in the nest, and an excellent breeder, usually rearing five or six pairs of squabs in the course of the season.

The *Mondain*, in general characteristics, closely resembles the Carneau, but it is larger and thicker in build, and is found in a great variety of colours, mostly interspersed with white; frequently, indeed, it is entirely white. In this breed the legs are in many cases more or less heavily feathered, a feature which must be regarded as detrimental to utility properties, since the quills upon the feet and toes are liable to puncture the eggs during incubation.

In both the Carneau and the Mondain the head is dove-shaped, full in the forehead, and well rounded behind. The eye, which varies considerably in colour, is somewhat prominent, and centrally placed. In specimens showing no white in the plumage the colour of the iris is usually yellow, and this is often the case with parti-coloured birds. White pigeons, however, as a rule possess a dark eye, though not invariably.

The bill is moderately long and slender, the wattle at its base being small and smooth ; eye-cere fine in texture and flesh-coloured.

Of first importance is the formation of the breast, which in a typical specimen should be long, deep and prominent. Narrow or flat-breasted pigeons are practically useless for utility purposes, and should be avoided, however good they may appear to be in other respects.

The back is wide at the shoulder, and tapers off towards the tail, which should be fairly short and narrow.

The wings are moderately long, powerful, and carried close to the body ; when closed they ought to meet, but not cross, over the tail.

The legs are rather short, stoutly formed and set-on sufficiently wide apart to give the bird a broad, " blocky " appearance, without being ungainly.

Of the two breeds described the Mondain is the more docile in disposition. It is a very prolific pigeon, and though its young whilst in the nest are a little less hardy than those of the Carneau, they mature quite as rapidly, and grow into finer squabs.

Housing.—Pigeons kept for utility purposes do best when confined in a loft or wired-in enclosure, and in arranging such a structure it is well to remember that as much air as possible must be allowed, also that freedom from wind and rain is absolutely essential. A lean-to aviary measuring about 10 ft. by 4 ft., and 6 ft. high, will accommodate half a dozen pairs of birds ; it should, however, be covered in for about four feet to protect the nesting boxes or lockers, which may be fixed to the wall by means of brackets. The lockers employed with the greatest success are constructed of boards a foot wide, cut into four-foot lengths, and placed one over the other about eighteen inches apart.

The shelves thus arranged are boarded at either end to the required height, and a door a foot wide is fixed in front at each extremity, leaving the centre open for the alighting board, which should project about six inches in order to facilitate ingress and egress. Behind each door is placed an ordinary earthenware nestpan, half filled with sawdust of medium grade.

This plan not only provides the necessary quiet for the pigeons whilst incubation is in progress, but it also permits of both pans being used simultaneously—an important consideration with quick-breeding pigeons, which generally have a second nest of eggs before the young of the first are old enough to care for themselves.

Pine sawdust, if procurable, is best for litter; it should be sprinkled thickly upon the floor of the nesting-boxes, also on the covered-in portion of the enclosure if the ground is hard and dry, but not otherwise. Its use materially assists in keeping the premises clean and sweet, and if it be raked over and sifted regularly there is no difficulty in collecting the loft droppings which have been absorbed. The latter, it may be remarked, are employed in the process of tanning, and are readily saleable for that purpose. The refuse must, however, be stored in a dry place.

As regards the outer flight, it is advisable, though not absolutely essential, that this also should be protected from rain. Wood and galvanized iron are equally useful for roofing purposes, the main point being to ensure a hard, dry floor, which can be kept clean.

Perching accommodation may be arranged according to circumstances and the space at command. Flat perches, about an inch wide, are preferable, as they are easily scraped down.

Breeding.—The breeding season proper commences about the first week in February, and continues until the end of September. Some pigeon-keepers advocate winter breeding; but unless relays of birds can be employed for the purpose, and warm quarters—artificially lighted—are at command, it is likely to prove unprofitable.

Actually mated pairs only should be admitted to the loft: all other birds, whether cocks or hens, constitute a distinct danger to the general harmony of the place, and must be rigorously excluded.

Previous to mating the sexes should be kept apart, as much fresh air and exercise as possible being allowed them, with a view to encouraging hard condition. A small quantity of hemp seed, added to the food supply, is useful at this time; barley also is to be recommended.

Only birds that are perfectly healthy should be employed in the stud, and on no account must closely related pigeons be mated together.

The best results are obtained by mating hens two or three years old with young cocks, or *vice versâ;* pigeons under the age of twelve months should never be allowed to breed together if robust offspring are desired.

When a selection of the breeding stock has been made, the intended pairs may be shut up together in the nesting boxes [illegible] ning

a small wire frame across the aperture of the locker. Here they may remain until nesting operations have commenced, after which the birds may be liberated for an hour or two each day until they have become accustomed to their surroundings, by which time complete liberty may be allowed. Two eggs only are laid, and the period of incubation is nineteen days.

The young pigeons, when first hatched, are practically nude, except for a scant covering of silky down, which gradually gives place to feathers as growth proceeds. Being entirely dependent upon the parent birds for their food supply, the squabs require no special attention at the hands of the owner, who should be careful to remember that it is advisable not to interfere with them for the first week or ten days, or the old pigeons may become restive and trample upon their offspring. Such precautions, however, need not be observed when the young are old enough to be left unbrooded by the parent birds ; it is then, indeed, an advantage to remove them from the nestpan and place them on the floor of the locker, where the old pigeons will continue to feed them. The nestpans should, during hot weather, be dressed with paraffin, both inside and out, as a preventative against red-mite.

The Food Supply.—The food offered to table pigeons ought at all times to be clean, dry, and thoroughly sound. It is false economy to feed on low-priced, apparently cheap grain, which is usually shrivelled, tainted, or otherwise unsuitable. The following mixture is useful for general purposes :—Equal parts of wheat (red), either white or maple peas, dari, and, during the cold weather, broken maize. To this may be added clipped oats, bread (crumbled), and coarse biscuit-meal, all of which, though not given to fancy pigeons, make excellent feeding for utility birds.

Buckwheat, hempseed, barley, millet and chicken-rice may also be employed with advantage from time to time, as a change. Such pulses as beans and tares are too expensive for general use, but both are of great value as flesh-formers. As regards maize, experience has proved that, while it can be freely fed to pigeons enjoying their liberty, it has a tendency to create fat in the case of confined birds, and if used without discrimination will ultimately ruin the stock for breeding purposes. For this reason it cannot be recommended for general use, though as already remarked, during cold spells it is distinctly beneficial.

Pigeons should be fed twice daily, in the morning and evening. In order that the food may not be fouled it is desirable to place it in a hopper or earthenware pan on the floor of the loft ; an ordinary nestpan answers admirably for the purpose, as it is easily cleaned and washed. Should it be

found impracticable to give an evening meal, sufficient food may be left in the hopper for the day's supply, which a little experience will enable the amateur to gauge almost to a nicety.

The grain supply should be stored in a cool, airy place, free from damp, and with as much surface exposed to the atmosphere as possible.

Shallow, open troughs are best suited for storage purposes, as the grain can then be stirred periodically and kept sweet and pure; it is also advisable to sift all grain previous to use in order to remove any dust or foreign matter. Grain, if stacked in bulk, is apt to ferment in warm, damp weather, and may cause bowel trouble if fed to the pigeons in that condition.

Grit and lime are both essential to the health of the flock. The first-named, which is necessary to promote digestion, may consist of good, hard flint grit, mixed with calcined (burnt) oyster-shell; while the lime may be given in the form of a mixture of old mortar rubbish, coarse sand and ordinary table salt, damped and allowed to dry off and cake. A vessel containing a supply of each of these commodities should be placed in the loft, under cover, and be replenished from time to time.

For holding drinking-water there is nothing better than the ordinary earthenware fountain, as manufactured specially for pigeons, and in general use among breeders. It must be cleaned and refilled regularly, and should be stood in a cool place away from the sun's rays.

Pigeons are inordinate bathers, and must be supplied with a wide, shallow water-pan, of which they will make the fullest use for cleansing and beautifying their plumage. A pan of galvanized iron, without any soldering, will be found most convenient; it should be offered every other day during the summer months, and twice a week in winter, care being taken to remove the vessel after use.

Preparing for Market.—Well-grown squabs are ready for killing when between four and five weeks of age; after that they lose flesh and are no longer the succulent morsels it is the business of the utility breeder to produce.

If the squabs have been properly nourished, no special preparation is required to fit them for the table, though it is customary in the trade to fatten imported birds by artificial means, probably because they become thin owing to the rough treatment to which they are subjected whilst travelling. Millet seed and tares are employed for this cramming process, which is carried out by experts; the amateur breeder, however, will find the work too troublesome to be profitable.

At the age above mentioned, the weight of a Mondain squab should be from 1 to 1¼ lb., and that of a Carneau somewhat less.

Occasionally a weight of 2 lb. is reached by extra fine specimens, but for all practical purposes squabs weighing a pound apiece, on an average, are sufficiently large, and likely to be better in quality than heavier birds.

There are two methods of killing, viz. :—By dislocating the neck, near the head, and by severing the jugular vein with a knife. The latter is most in vogue among breeders supplying the London and other big markets, but there seems no real reason why breaking the neck, as practiced with poultry, should not be equally effective, seeing that, when properly performed, the operation is cleaner and completely drains the body of blood.

After killing, the body should at once be denuded of feathers and hung up to cool. Care must be exercised in plucking not to tear the skin, or there will be disfigurement and subsequent loss in value.

Dressing next follows, and is easily performed by folding the wings behind the back, and tucking the legs backward under the thigh. There is no necessity to remove the intestines at this stage.

The appearance of the carcass can be greatly improved by placing it, breast downwards, on a shaping board similar to that used for poultry. If the birds are laid out in a row and the top board is well weighted, they will quickly assume the required flatness, after which they are ready for packing. Shallow boxes, constructed to hold either six or eight pigeons, are used for this purpose; they should be lined with clean, white paper, crimped at the edges.

In some districts dealers prefer to buy live pigeons rather than those already dressed. Only birds, however, known as "squeakers," that is those which still utter the nestling note, are suitable for this market, a point the intending breeder will do well to bear in mind.

ENSILAGE.

THE system of ensilage was at first advocated mainly as a resource when wet weather prevented the saving of the hay crop in good condition, the contention being that it was preferable, under such circumstances, to convert grass and other fodder crops into silage. It was on these grounds that the system was first widely adopted in the year 1888. It may be reasonably

claimed, however, that the utility of the system is equally, if not more, marked in a year of drought, or when the root-crop fails, as by its means green fodder may be economised and stored *in a succulent state* for winter keep.*

When ensilage was first introduced it was generally considered that the making of silage involved the construction of a silo, *i.e.*, a receptacle of some kind with sides of brick, stone or concrete. This was often too expensive for tenant farmers, and in some cases outhouses, parts of barns, and other buildings were converted for use as silos at comparatively small cost. A considerable stimulus, however, was given to the system by the discovery that good silage could be made in stacks and clamps by a comparatively cheap and simple process.

Materials Suitable for Silage.—Meadow grass, Italian ryegrass, grass and clover mixtures, maize, lucerne, clover, sainfoin, vetches, and any other green fodder crops that can be spared from the immediate requirements of the farm stock may be made into silage. As a rule the four last-mentioned crops, and legumes generally, make the best silage when mixed with a grass or a cereal. Hay aftermath, top-dressed if necessary with quick-acting manures, might also be converted into silage, especially when weather conditions are apt to render the saving of a second hay crop difficult or impossible. At several centres in the South-Eastern Counties, where roots are often a precarious and costly crop, a considerable proportion of the root "break," for the past year or two has been specially devoted to the growth of silage crops, usually a mixture of vetches, cereals and a sprinkling of beans. Sown in autumn this mixture proves an effective "smother" crop, and is ensiled during the early part of July. As soon as possible after the removal of the crop the land is broken up and usually fallowed till wheat is sown in autumn. In some cases, however, it is found possible to follow immediately with a quick-growing green crop, such as rape, mustard or soft turnips. In America by far the most important silage crop is maize, to the cultivation of which increased attention has been given in recent years in England. For an account of the cultivation of maize for fodder, Leaflet No. 73 may be consulted.

If the object in view is to provide for the deficiencies of a season of drought, autumn silage crops should be allowed to stand as late as the weather will permit.

All classes of herbage upon farms may, if necessary, be utilised for silage, even nettles and other weeds having been successfully

* See also p. 372.

employed. The margins of fields and the sides of hedges and other waste places may be brushed and the material so obtained ensiled. The leaves and young shoots of most hardwood trees may also be utilised. If the material is too coarse for actual silage it will be useful for topping up the silos, stacks, or clamps. Coarse grass in meadows, pastures, and under trees in orchards and elsewhere, which stock frequently reject, may be made into eatable silage. Hop bines may be ensiled directly the hops have been picked, before the sap has disappeared.

Making of Silage.—Silage may be made in special pits, in stacks or clamps, in ordinary buildings adapted for the purpose, or in a specially designed structure, such as the round stave or concrete silo so popular in America. Although the details of the various methods of making silage differ somewhat, the main features are the same in all. The chief essential is compression, to exclude air, and this object is usually best attained when the silage crops are cut while still immature and carted soon afterwards.

Silage made in a silo or clamp is usually sour, while silage made in a stack is almost invariably sweet. To prepare sweet silage the material should be added somewhat slowly to ensure a temperature of from 130° F. to 160° F., which apparently renders inactive the organisms in the material which are responsible for the production of acids. If by rapid filling and pressure air is excluded the temperature does not rise so high and sour silage is produced.

The results of feeding trials and chemical analyses show that there is no marked difference in the feeding value of sweet and sour silage. The sweet variety, however, has a less powerful smell, and on that account is to be preferred in the feeding of milch cows.

In the case of the stack or clamp or other temporary silo no special preparation of the silage crops is necessary before ensiling. When, however, the tall, round stave or concrete silo is used, the material is usually roughly chaffed before it is transferred to the silo by elevator or blower.

Silage Stacks.—Silage is stacked in the same way as hay, in circular, square, or oblong stacks. It is important that as much material as possible should be put together in one stack so as to reduce waste at the outside. A depth of 3 or 4 feet is put on every day or two and care must be taken that the temperature does not rise above 150° F. Rise of temperature is checked by throwing on more fodder so as to increase the pressure. As building progresses the stack must be carefully and firmly trodden, especially near the outsides, and the fodder should be

thrown on from different sides in succession. In the case of square or oblong stacks poles may be pitched at the corners and sides, and braced together at the top to guide the stack makers. A framework of four large planks may be made round the poles, and drawn up as the stack progresses by pulleys fastened to each end of the bracing at the top. This will keep the stack shapely, and allow the outsides to be well trodden down. The boards may be used to cover the stack when finished, and then be heavily loaded with bricks, stones, or other weighty substances. The whole should be covered with straw or other material to keep out rain.

Round stacks should be built slowly and not weighted until complete. A layer of rough grass or weeds should be put at the bottom, and similar material used to top up. The surface should be trodden down, and sand or earth laid on the top to a depth of not less than 12 inches. The usual procedure is to dig a trench round the stack, and use the soil thrown out to cover the silage. Sand and earth have been found the most useful materials to ensure even pressure. Finally, a layer of rushes, bracken, or similar material may be put on and weighted down to act as thatch. In building the stack it should be kept full in the middle, in order that it may finish convex. Materials for making a silage-stack should, as a rule, be used whole, and be carted immediately after cutting.

The system of making silage in stacks involves the waste of a certain amount of material round the outsides. The method, however, is very valuable, especially in cases of emergency. The initial expense of making a silo is saved, and a stack can be erected in any convenient position.

Silage Clamps.—Clamps are advocated by practical men in the absence of a silo, when silage must be made immediately. They are best made on slightly sloping ground and should be oblong in shape. The carts should be drawn on and over the heap precisely as in the case of a manure clamp, and tipped where material is required to fill up. They must be drawn as closely to the sides as possible so as to give pressure there. When the middle has risen too high for further carting the sloping ends and sides should be cut off, the material being thrown on to the clamp, levelled, and firmly trodden in. Good silage can be obtained by this method from very wet material. Finally, dry earth should be laid evenly upon the clamp, to a depth of 10 inches, preferably with an intervening layer of rough herbage, bracken or leaves.

Old chalk pits, so numerous in some districts, form serviceable receptacles for silage. The carts should be led over the

mass of green material, which must be finally left in a somewhat conical form, and covered with earth to a depth of from 10 to 12 inches.

Where earth is used as a covering for silage stacks or clamps, occasional inspection is necessary, as the earth sinks with the silage, and cracks are sometimes formed. These cracks should be filled up.

Silos.—Specially constructed silos will naturally be used when available, but buildings that can be readily and economically converted may be utilised as temporary silos. Cheap stave or concrete cylindrical silos, now so common in America, may also be built. These silos are usually from 20 to 40 feet high and from 10 to 20 feet in diameter. The following table shows the relation between the size and capacity of silos of different dimensions:—

Approximate Capacity of Cylindrical Silos for well-matured Maize Silage in tons (King, Wisconsin).

Depth of silo (feet).	Inside diameter of silo (in feet).					
	10.	12.	14.	16.	18.	20.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
20	26	38	51	67	85	105
22	30	43	59	77	97	120
24	34	49	66	87	110	135
26	38	55	74	97	123	152
28	42	61	83	108	137	169
30	47	68	93	119	151	187
32	51	73	101	131	166	205
36	64	105	130	155	190	235
40	75	121	150	180	228	279

It is stated that somewhat larger quantities of immature crops can be compressed into the same space. The material is first chaffed by power, and then elevated into the silo. The deep stave silo has a number of advantages. It can be made practically air-tight. The chaffing of the fodder and the greater depth of the silo as compared with its diameter ensure sufficient compression without artificial weighting. The smoothness of the walls ensures uniform settling, and the loss from spoiled silage, both at the top and as emptying progresses, is relatively low.

The cost of cylindrical silos will vary according to the relative prices of timber and cement. At the present time a stave silo, 36 feet deep, and 18 feet in diameter would cost about £150.

The Use and Value of Silage.—Many stock-owners make silage regularly, and use it as a valuable addition to ordinary

food for stock. There is abundant testimony as to its value for feeding milch cows as well as breeding ewes. For fattening beasts it has been claimed that well-made silage is as valuable as a combination of hay and turnips, and for lean stock of all kinds it may be used as a substitute for either hay or roots. Farm horses will do well on properly-made silage.

As a rule silage should not be mixed with other forage when fed. About 40 lb. per day is a common allowance for a cow. In seasons when hay and straw or roots are scarce, silage will prove of great value for supplying the bulky succulent food that is essential for the health of ruminants.

NOTE.—The subject of ensilage received considerable attention at the hands of the Agricultural Department of the Privy Council in 1885, and, as the result of an exhaustive local inquiry, a summary was published of Replies to Questions on Silos and Ensilage in Great Britain, in the form of a Parliamentary paper.* This was followed by a reproduction of the Reports of the private Ensilage Commission.†

The Composition and Value of Liquid Manure.

THE chemical composition of liquid manure as produced under the farming conditions of the North-East of Scotland is discussed in a bulletin‡ published by the North of Scotland College of Agriculture, and an account is given of the results obtained over a series of years with this manure for the hay crop.

Liquid manure, it is explained, consists mainly of the urine of animals and of the drainage from manure heaps during the rotting of the dung, mixed in many cases with rain water. The urine is the most important part, and contains both nitrogen and potash, but very little phosphate. Its potash content has increased the value of urine since the outbreak of war, as German sources of potash manures have been cut off.

The quality of the urine depends to a large extent upon the amount of water taken by the animal with its food. Turnips, *e.g.*, contain about 90 per cent. of water, and as it has been repeatedly shown that from 50-60 lb. of turnips contain sufficient water for the requirements of bullocks,

---

* C.—4536. † H. C. 308 of 1885 and H. C. 119 of 1886.

‡ North of Scotland College of Agriculture, Bull. No. 19, *The Composition and Value of Liquid Manure*: Professor James Hendrick.

it follows that the larger the quantity of turnips above this consumed, the poorer is the quality of the urine. Two experiments, in Scotland and England respectively, are cited by Professor Hendrick to illustrate the point. The amount and quality of the urine obtained in these experiments by varying the root feeding is shown in the following tables :—

Scottish Experiment.

Food per Day.			Excretion.		Urine Content in	
Turnips.	Straw.	Linseed Cake.	Dung.	Urine.	Nitrogen.	Potash.
lb.	lb.	lb.	lb.	lb.	Per cent.	Per cent.
119	9½	0	29	58	0·22	—
60	13¼	3	30¾	15½	0·58	—

English Experiment.

Food per Day.			Excretion.		Urine Content in	
Mangolds.	Lucerne Hay.	Water.	Dung.	Urine.	Nitrogen.	Potash.
lb.	lb.	lb.	lb.	lb.	Per cent.	Per cent.
150	0	0	42	88	0·124	0·597
0	26	66	48	14	1·54	1·69

In districts, therefore, where dry foods are mainly used and roots are given only in small quantity, or not at all, the bulk of the urine is small, easily soaked up in the litter, and retained in the dung. Under such conditions the dung is enriched by the nitrogen and potash of the urine and it is less necessary to make special arrangements for dealing with liquid manure.

The importance of the proper collection of the urine where large quantities are produced is increased by the consideration that the nitrogen in the roots, which produce these large quantities, is very well digested, so that only 10 or 20 per cent. of the total nitrogen is contained in the dung, at least 90 per cent. of the remainder being voided in the urine ; and the same holds true as regards the potash. Further, the nitrogen and potash in the urine are in a form immediately available for the use of crops, so that both these manurial ingredients are, weight for weight, as valuable and as quick-acting as those of any other manures the farmer can purchase. The nitrogen and potash in the dung and the straw are, on the other hand, relatively slow in their action on crops.

In the present investigation 35 samples of liquid manure from farms in the North-East of Scotland were analysed, with the following results :—

—	Average per cent.	Maximum per cent.	Minimum per cent.
Water	98·21	99·33	96·46
Solids	1·79	3·54	·67
Total Nitrogen	·204	·470	·088
Including Ammoniacal Nitrogen	·179	·410	·060
Phosphoric Acid	·029	·090	·004
Potash	·462	1·030	·128
Lime	·019	·043	·003

In the feeding a considerable quantity of turnips was used, together with straw, and sometimes a little hay; oats and various kinds of cake were added to this basal ration, and in the case of milking cows some "draff" (wet grains) was also used. The varying amounts of rain-water which gained access to the collection tanks in different instances caused much greater differences in the composition of the various samples than the feeding; so far as the evidence went, however, it did not indicate that even if rain were entirely excluded from the tanks the average solids would be much higher than 2 per cent. or the average nitrogen above 0·3 per cent.

The weight of 1,000 gallons of liquid manure would be about 10,000 lb. or nearly 4½ tons. This quantity would contain :—

Nitrogen, about	20½ lb.
Phosphoric Acid, about	3 ,,
Potash	46¼ ,,
Lime	2 ,,

The content of nitrogen would be equal to that present in 100 lb. of sulphate of ammonia, and, on the basis of 7*d.* per lb. of nitrogen, would have a value of 12*s.* The potash is more than that present in 3 cwt. of kainit, and at the pre-war price of 2*d.* per lb. might be valued at 8*s.* The value of the phosphoric acid present would be about 7*d.*, while the lime would have practically no value. Liquid manure as collected in the North-East of Scotland would, therefore, have a value of about 4*s.* 6*d.* per ton as manure, reckoning the potash at pre-war prices, or of about 6*s.* 3*d.* per ton, assuming potash to have doubled in price.

Liquid manure is suitable for a good many crops, but hay was chosen for these experiments on account of the ease with which the results of application could be ascertained.

The applications were carried out at different times during the winter, viz.: (1) in December, (2) at the end of January, and (3) in March, as it was thought that in the case of the two earlier dressings, in spite of assertions by practical men to the contrary, little of the potash would be lost and that a great part of the nitrogen might also be saved. The standard dressing of liquid manure adopted was 2,000 gal. per acre, which was generally given in two dressings of 1,000 gal. each at an interval of a few days. For distribution purposes a barrel-cart was used.

In all, twelve experiments were carried out over four seasons, and in every one a marked increase of crop was obtained from the application of liquid manure; further, the increase obtained by applications in December was, on the average, about as great as that obtained from March applications. This is brought out in the following table:—

——	Time of Application.	Weight of Hay per Acre.
		lb.
Untreated	.. ..	4,512
2,000 gal. per acre ..	December	5,557
2,000 " " "	January or February ..	5,768
2,000 " " "	March	5,610
1,000 " " "	December	5,719
1,000 " " "	March	
2,000 " " "	December	6,075
2,000 " " "	March	

With fine, mild weather early in the season plots receiving an early dressing began to grow early and obtained a start over those dressed later; but with a cold and wet early season the advantage of the early-dressed plots was more or less lost; while with dry weather in May and June the plots dressed late, especially on light, thin land, were retarded by the drought, and the advantage of the plots dressed early was increased.

For practical purposes, therefore, Professor Hendrick recommends dressing at intervals throughout the season as might be found convenient, each part of the area being gone over two or three times in the course of the winter.

From the financial point of view the experiments showed that (valuing the hay at 51s. per ton) about 25s. per acre was obtained from an application of 2,000 gal. of liquid manure, quite apart from the value of the improved aftermath, which was undetermined, but estimated at 5s. per acre. If the

unexhausted value of the potash is placed at one-half the original dressing (*i.e.*, 8*s.* per 2,000 gal. at pre-war prices) the total return would seem to have been about 38*s.* from the liquid manure, the value of which, based on its manurial ingredients, was placed at £2 (see above).

The dressing of 4,000 gal. per acre was shown to give an insufficiently good return for the extra 2.000 gal. applied (see above table).

Treatment with liquid manure had a beneficial rather than a detrimental effect on clover.

In conclusion, Professor Hendrick points out, that when liquid manure is applied to pasture, the latest dressing would require to be given some weeks before the cattle are to be turned on to the grass, so that all trace of the liquid manure and its smell, which would probably interfere with the relish of the cattle for the grass, would have had time to disappear. Probably it would be an additional benefit, in the case of pasture, that an early growth would be obtained which would provide food for stock at a time of year when it is often scarce.

The International Institute of Agriculture: Proceedings of the Permanent Committee.

AT the meeting of the Permanent Committee held in April there was little business of importance to be done, but as the date for the Meeting in May approached, and it became more and more probable that Italy would take part in the European War, the tension in Rome became greater, and the difficulty of carrying on the work of the Institute increased. The Delegates for Austria and Hungary left Rome, and the members of the Staff who belong to those countries and to Germany found it advisable to return to their homes. According to the regulations, the Permanent Committee should hold a meeting in the month of June, but there was a general feeling among the Delegates that it would be better in the permanent interest of the Institute that they should wind up the work of the Session and separate before the state of war actually arose. Accordingly, at the meeting of the 18th May the Committee decided to begin the annual vacation at once, and to leave the President and the Staff to maintain the working of the Institute, so far as it was possible to do so in the present critical circumstances. Now that Italy has entered into the war, nearly half of the Permanent Staff, which ordinarily consists of about a hundred members,

have had to leave Rome either because they have been summoned to serve in a military capacity, or because they belong to countries at war with Italy, so that it will be impossible for the Institute to do so much work as is ordinarily to be expected from it. The Committee, however, directed the Staff to ensure that the three monthly Bulletins are issued as regularly as possible, to endeavour to issue the new Statistical Annual in the month of August, and to publish in August or September statistical tables relating to the production, import, export, prices and freights of cereals, similar to the tables circulated in the month of March. They hope in this way to be able to keep the current work up to date, to meet again as usual in the month of October, and when peace is declared to resume the functions of the Institute with full vigour.

As it was recognised that, should Italy enter into the war, it would be impossible for the employees belonging to hostile countries to remain at Rome, the Committee decided to extend to them, even if they were not summoned to military duty, the same generous treatment which it had already granted to employees belonging to the belligerent countries who had been called to the colours. That is to say, they were to be allowed during their enforced absence a maximum of six months' pay, and to be permitted, so far as possible, to resume their duties at the Institute on the conclusion of peace.

In accordance with the desire of the representatives of the English-speaking countries, it was resolved to adopt new titles for the English edition of the three monthly Bulletins, more intelligible to English readers than the present titles, which are too close a translation of the French. The new titles will be (1) International Crop Report and Agricultural Statistics, (2) International Review of the Science and Practice of Agriculture, (3) International Review of Agricultural Economics.

Advice to Pig Feeders.

THE Department of Agriculture and Technical Instruction for Ireland consider that the following opinions expressed by the Committee on the Irish Pig Breeding Industry cannot be too widely known :—

1. The prospects of the industry are good. The numbers of pigs in countries which export bacon to Great Britain are falling off, and it may be anticipated that, in consequence, exports of bacon will shrink, and that Irish bacon will be in great demand. The number of pigs in Ireland should, therefore, be increased.

2. It is not necessary to cook meals for pigs. Steep the meals in cold water and feed raw ; just as good results will be obtained and labour and fuel will be saved.

3. About 5 cwt. meal will produce 1 cwt. pork.

Given in conjunction with other foods—

About 4 lb. potatoes equal 1 lb. meal in feeding value.

About 6 lb. separated milk equal 1 lb. meal in feeding value.

Separated milk given with meal and potatoes is now worth *2d.* per gallon.

4. Farmers should breed the pigs they fatten, and thus secure the profit of both breeder and feeder.

5. More home-grown foods should be produced for feeding to pigs. Barley, oats and potatoes are most suitable.

The Department learn that in some cases farmers have used cod-liver oil in the food for pigs. This is a most undesirable practice, as the oil imparts an objectionable, fishy flavour to the pork, which is not removed even by the process of curing.

Farmers, therefore, are most strongly urged not to feed cod-liver oil to pigs under any circumstances. The use of this oil is not necessary ; it injures the reputation of Irish bacon ; it is unfair to bacon curers, and, above all, it re-acts against the farmers' own interests.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

The Atmosphere of the Soil (*Jour. Agric. Sci.*, March, 1915 ; *E. J. Russell* and *A. Appleyard*).—The free air in the pores of the soil to a depth of six inches is very similar in composition to the atmospheric ir, but it differs in that it contains more CO_2 and correspondingly less xygen and shows greater fluctuations in composition. Usually the um of the CO_2 and oxygen is only slightly less than in atmospheric air, ut at periods when nitrates rapidly increase there is a perceptible alling off of oxygen, and a still greater one in waterlogged soils.

Besides this free air there is another atmosphere dissolved in the vater and colloids of the soils ; this consists mainly of CO_2 and nitrogen ut practically no oxygen.

The fluctuations in composition of the free soil air are mainly due o fluctuations in the rate of biochemical change in the soil. The rate f biochemical activity attains a maximum value in late spring and again n autumn, and minimum values in summer and winter. In autumn he bacteria increase first, then the CO_2 rises, and finally the nitrate ncreases.

---

* A summary of all reports on agricultural experiments and investigations ecently received is given each month. The Board are anxious to obtain for nclusion copies of reports on inquiries, whether carried out by agricultural olleges, societies, or private persons.

The dominating factor appears to be, from November to May, the soil temperature and, from May to November, the rainfall and to a less extent the soil moisture. Rainfall, besides adding water to the soil, brings in dissolved oxygen which is probably a factor of considerable importance in renewing the dissolved soil atmosphere and facilitating biochemical change.

No evidence could be obtained that the growing crop markedly increases the amount of CO_2 in the soil air, and if it gives rise to any great evolution of CO_2 in the soil it apparently exercises a correspondingly depressing effect in the activities of soil bacteria.

Such weather conditions as barometric pressure, wind velocity, variations in temperature from the mean, small rainfall, etc., seem to have but little effect on the soil atmosphere.

The Manurial Values of Corn and Cake Compared (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—In 1910 swedes were fed on the land to sheep with corn and cake respectively. The succeeding crops were barley in 1911, green crops in 1912, wheat in 1913, and swedes in 1914. The following table shows the results obtained :—

Year.	Crop.	Corn-Fed Plot.	Cake-Fed Plot.
		Per acre.	Per acre.
1911 ..	Barley ..	28·5 bush.	23·8 bush.
1912 ..	Trifolium (cut as hay)	1 ton 19½ cwt.	1 ton 16¾ cwt.
1913 ..	Wheat ..	26·7 bush.	22·7 bush.
1914 ..	Swedes ..	7 tons ¼ cwt.	6 tons 19 cwt.

The superiority of the manurial value of the corn over that of the cake is unexpected, and the experiment is being repeated.

Green Manuring (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—On Stackyard Field, in 1914, rape proved the best green manure crop for wheat, both as regards yields of corn and straw, mustard coming second, while the crop after tares was the smallest of the three.

Relation of Lime to Magnesia in Soils (*Woburn Pot Culture Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—In 1914 barley, the sixth consecutive corn crop, was grown in this test. It is clear from this trial that the addition of lime to a soil rich in magnesia is beneficial, and that lime can be applied without detriment even where the lime is double the amount of magnesia present in the soil.

Experiments on the Acidity of Soil (*Woburn Pot Culture Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—Soil was taken from various continuous barley plots in the Stackyard Field at Woburn, and the acidity and amount of lime required for neutralisation determined by Dr. Hutchinson (see this *Journal* June, 1915, p. 255). The soil from each plot was then treated in three different ways, viz., (1) untreated, (2) sufficient lime added to neutralise the acidity, and (3) an excess of lime added. The lime was added in the form of finely-ground carbonate of lime.

In two plots on which sulphate of ammonia had been applied alone and along with mineral manures respectively, soil acidity had gone so far that a crop could not be produced, and in these cases it

was found that carbonate of lime could advantageously be added to an extent exceeding that required to neutralise the acidity present. But where, although acidity was indicated, a fair crop was still obtained, as was the case on the unmanured plot and the plot that received both sulphate of ammonia and four tons of lime (1897 and 1905), no advantage was obtained by adding carbonate of lime even to neutralising point. Lastly, when no acidity at all was shown, as was the case on two further plots which had received lime dressings, further liming was shown to be thrown away.

In no case was any harmful effect obtained from using carbonate of lime, and it is thought that there is no doubt that the harmful effects of liming on one of the plots in the continuous wheat experiment must be due to the fact that lime was applied there in the caustic state.

Radio-Active Manure (*New Jersey Agric. Expt. Sta., Bull.* 269).—Pot experiments were carried out with a radio-active manure sold at £42 per ton by the Radium Products Corporation of New York City. No appreciable effects, one way or the other, were produced.

Sulphur as Manure (*Fühling's Landw. Ztg.*, 1st and 15th May, 1915.)—The experiments carried out with sulphur in recent years are reviewed and the results carefully analysed. The conclusion is reached that no case has been made out for the use of sulphur as manure in agriculture.

FIELD CROPS.

Varieties and Selection of Seed of Flax (*Jour. Dept. of Agric. and Tech. Instr. for Ireland*, April, 1915).—The average returns per acre, at ten centres, from flax and tows in the case of the varieties tested, were as follows :—

Variety.	Returns. £ s. d.
Dutch Riga Child, imported by the Department	14 17 7
Belfast Dutch, purchased in Ulster	11 11 3
Irish Saved, 3rd year's selection	8 18 7
Pernau Crown, imported by the Department	12 17 11
Belfast Riga, purchased in Ulster	11 14 8

These results, taken in conjunction with those of previous years, are considered to afford conclusive proof that the choice of the variety of flax seed to be sown (*i.e.*, whether Dutch or Russian) should not be governed either by the class of soil or by the district for which it is intended, but by the quality of the seed itself.

In a further series of trials in 1913, the largest monetary returns were obtained from the standard varieties of seed, viz., Pernau Crown and Dutch Riga Child, as compared with three different classes of Irish saved seed and four varieties of seed from the more easterly flax growing districts of Russia. Old seed of Pernau Crown (*i.e.*, grown in 1911) gave slightly better results than the new seed of this variety.

The tests, which sought to ascertain whether the flax plant could be improved for fibre production by making in successive years a selection of seed from long stalks, were continued in 1913. Seed specially selected in this way gave an approximately equal yield of straw, but as regards flax inferior results both in scutching and in spinning were obtained, as compared with Pernau Crown seed. In the previous trials the specially selected Irish seed of the same strain gave in 1911 superior, and in 1912 only slightly inferior, results to Pernau

Crown. The poor results in 1913 may perhaps indicate that these strains of seed lose their original vigour when grown for successive generations in Ireland; and it is stated that it does not appear hopeful that it will be possible in Ireland to improve the flax plant for fibre production by making in successive years a selection of seeds from long stalks.

Manuring of Flax (*Jour. Dept. Agric. and Tech. Inst. for Ireland,* April, 1915).—The experiments conducted by the Department from 1901 to 1912 showed the application of potassic manures to the flax crop to give profitable increases; kainit and muriate of potash, which were abont eqnal in value, gave better results than sulphate of potash. There was no difference in the results from the first two whether they were applied in winter or at the time of sowing.

The use of phosphatic manures was almost invariably attended with a loss, owing to the encouragement of the growth of weeds; and the application of agricultural salt was not remunerative.

Variable results were obtained in different seasons and at different centres with sulphate of ammonia, and the 1913 experiments were, therefore, designed to test this manure further. On the average of 10 centres a higher yield of 3 st. 11 lb. of scutched flax per acre resulted from the application of ½ cwt. sulphate of ammonia per acre in 1913, which left a profitable increase of £1 4*s*. 3*d*. after deducting the cost of the manure.

The addition of ½ cwt. sulphate of ammonia to dressings of 1½ cwt. and 1 cwt. muriate of potash per acre gave, on the average, increased profits over those from the potash dressings alone of 11*s*. 11*d*. and 13*s*. 8*d*. per acre. These and former results are taken to show that in most seasons the addition of a light dressing of sulphate of ammonia to muriate of potash will prove effective.

More remunerative results were obtained in 1913 from the application of 1½ cwt. muriate of potash than from 1 cwt. of this manure per acre, whether applied alone or along with sulphate of ammonia.

Liming for Flax (*Jour. Dept. Agric. and Tech. Instr. for Ireland,* April, 1915).—The lime was applied in 1912 at the rate of 2 tons of burnt lime per acre, and the plots were cropped in 1912 with oats and in 1913 with flax. On both the limed and unlimed plots the effect of 1 cwt. muriate of potash was tested for the flax crop. The profits from the dressings were as follows (one-quarter of the cost of the lime is charged to the flax):—

	Profit over Untreated Plots.
Untreated	—
1 cwt. muriate of potash	6*s*.
2 tons burnt lime	£2 9*s*. 10*d*.
2 tons burnt lime 1 cwt. muriate of potash	£4 0*s*. 4*d*.

Green Manuring of Barley (*Rothamsted Expt. Sta., Ann. Rept. for* 1914; *E. J. Russell, D.Sc.*).—Four crops were ploughed in and the following yields of barley were obtained per acre:—Rape: grain 18·9 bush., straw 15·4 cwt.; crimson clover: grain 15 bush., straw 14 cwt.; vetches: grain 21·5 bush., straw 18·9 cwt.; mustard: grain 18·8 bush., straw 15·1 cwt.

Growth of Barley after Leguminous Crops (*Rothamsted Expt. Sta., Ann. Rept. for* 1914; *E. J. Russell, D.Sc.*).—Barley was grown after various legumes in order to test the amounts of nitrogen accumulated

by the latter and left in the soil. After lucerne, the yield per acre was 33 bush. of grain and 17·6 cwt. of straw; after red clover, 20·3 bush. of grain and 10·6 cwt. of straw; and after alsike clover, 21·9 bush. of grain and 11·3 cwt. of straw.

Varieties of Oats (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—The yields of head corn per acre, in bush., were:—Svalöf Victory 37·4, Banner (Canadian) 34·5, Mammoth White Cluster (Canadian) 32·8, Newmarket 32·7. Svalöf Victory also produced most straw and obtained the best price in the valuation.

Manuring of Oats (*Rothamsted Expt. Sta., Ann. Rept. for* 1914; *E. J. Russell, D.Sc.*).—Winter oats manured with 106½ lb. of nitrolim per acre yielded 2 bush. of grain per acre more than those receiving the same amount of nitrate of soda and nearly 5 bush. per acre more than unmanured oats.

Clover and Grass Mixtures (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—The merits of wild white clover and ordinary white clover for inclusion in seeds mixtures were tested. A mixture containing wild white clover yielded 1 ton 19 cwt. of hay per acre; the same mixture, substituting an equal weight of ordinary white clover seed for the wild white clover, yielded 2 tons 4 cwt. per acre; on a third plot wild red clover sown alone produced 9½ cwt. After the removal of the hay, however, the wild white clover was found to cover the ground more closely than the ordinary variety, giving a much thicker "bottom" for pasturage. The same was noticeable with the wild red clover.

Varieties of Lucerne (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—Seven varieties of lucerne were compared in 1914, as for several years past, both when sown under a corn crop and when sown bare. The yields per acre in 1914 were as follows:—

Variety.	Sown under a Corn Crop.		Sown Bare.	
	Tons.	cwt.	Tons.	cwt.
Russian (Europe)	4	4	3	17
Canadian	3	14	3	12½
Provence	3	9½	3	9½
North American	3	9	3	9½
Russian (Asia)	3	2½	3	10½
American (Arizona)	2	1½	1	13
Turkestan	1	7¼	1	8½

As in 1912 and 1913, the highest yield was obtained with the Russian (Europe) variety, the Canadian coming next, and the Provence third. In 1912 and 1913 a higher yield was obtained from the plot on which only lucerne was sown, but in 1914 this difference disappeared.

Varieties of Linseed (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—Four kinds of linseed were sown on duplicate plots in 1914. La Plata yielded 20·3 bush. of seed and 14 cwt. of straw, Morocco 19·9 bush. of seed and 15¾ cwt. of straw, Steppe 15·1 bush. of seed and 17¾ cwt. of straw, and White-flowering (Dutch) 12·2 bush. of seed and 21 cwt. of straw per acre. The averages of the

duplicate plots are given. The Morocco variety contained 39·47 per cent. of oil in the seed, La Plata 38·85 per cent., Steppe 37·88 per cent., and White-flowering (Dutch) 34·06 per cent. The White-flowering (Dutch) seed was subsequently found to have been of inferior quality, thus lessening the value of the comparison of it with the other varieties.

Varieties of Rye-grass (*Woburn Field Expts.*, 1914 ; *Jour. Roy Agric. Soc.*, 1914 ; *J. A. Voelcker, D.Sc.*).—Three varieties of rye-grass have been tested for three years, and the following yields of hay have been obtained (per acre) :—

Variety.	1912.	1913.	1914.
	Tons. cwt.	Tons. cwt.	Tons. cwt.
Pacey rye-grass ..	1 7	1 6¼	1 16¾
Dutch ,, ..	1 15¾	0 17	1 19¾
Italian ,, ..	2 11¾	0 19¾	2 5½

Germination of Mangolds (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—A medium loam soil was treated with 15 tons of dung and, later on, 2 cwt. dissolved bones, 1 cwt. superphosphate and ½ cwt. sulphate of ammonia per acre ; 1 cwt. nitrate of soda was applied per acre as a top dressing. The variety of mangold was Sutton's Prizewinner. The treatment of the seed and the yields obtained were as follows (per acre) :—

	Tons.	cwt.
Seed, ordinary form, 8 lb.	34	15
Seed, crushed, 8 lb.	35	0
,, 6 ,, ...	35	5
,, 4 ,, ...	33	15
Seed soaked 24 hours before sowing	35	0

All the methods of treatment retarded the germination of the plants at first, as compared with the untreated seed.

Top Dressing of Mangolds (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—The field was on a heavy loam soil and received 2 cwt. dissolved bones, ½ cwt. sulphate of ammonia, and 1 cwt. superphosphate per acre at the time of sowing. The experiment was designed to test the values of different manures applied as a top dressing after singling. Sutton's Prizewinner was used, the seed being drilled at the rate of 7 lb. per acre. All the plots except Plot 1 received the standard dressing. The various top dressings, and the yields per acre were as follows :—

		Tons.	cwt.
Plot 1.	No manure and no top dressing ..	20	17½
,, 2.	No top dressing	24	18¾
,, 3.	1 cwt. superphosphate	26	5
,, 4.	1 ,, nitrate of soda	27	2½
,, 5.	1 ,, nitrate of lime	25	5
,, 6.	1 ,, nitrolim	25	7½
,, 7.	1 ,, nitrate of ammonia	26	7½
,, 8.	1 ,, nitrate of soda	26	0

Manuring of Mangolds (*Rothamsted Expt. Sta., Ann. Rept. for 1914 ; E. J. Russell, D.Sc.*).—The addition of 220 lb. of nitrate of lime to a dressing of 12 tons of dung, 3 cwt. of superphosphate, ¾ cwt. of muriate of potash and ½ cwt. of salt per acre applied to mangolds gave considerably better results than the addition of either 175 lb. of nitrolim or 80 lb. of nitrate of ammonia per acre to the same dressing. Sulphate of manganese, at the rate of 35 lb. and 25 lb. per acre, when added to the above dressings caused a diminution in the crop in every case.

Varieties of Mangolds (*Rept. on Field Expts. at Harper Adams Agric. Coll.*, 1914).—A heavy loam soil was used for these trials, and 2 cwt. dissolved bones, 1 cwt. superphosphate, and ½ cwt. sulphate of ammonia per acre were applied before ridging, with 1 cwt. nitrate of soda per acre as a top dressing in July. The mangolds were drilled at the rate of 8 lb. per acre on 15th May.

The yields of the Yellow Globe varieties were :—Toogood's Masterpiece, 32 tons 12½ cwt. ; Sutton's Prizewinner, 30 tons 17½ cwt. ; Webb's Smithfield Yellow Globe, 30 tons 15 cwt. ; Garton's Large Yellow Globe, No. 15, 30 tons 12½ cwt. ; Dickson's Triumph Yellow Globe, 30 tons 7½ cwt. ; Clibran's Colossal Globe, 29 tons 15 cwt. ; Clibran's No. 1 Globe, 29 tons 15 cwt. ; Middlehurst's Prizetaker, 29 tons 12½ cwt. ; Sutton's Up-to-Date, 29 tons 7½ cwt. ; Dickson and Robinson's "Defiance," 28 tons 5 cwt. ; Garton's Large Yellow Globe, No. 28, 26 tons 7½ cwt. ; Garton's Large Yellow Globe, No. 53, 25 tons 17½ cwt. ; Little and Ballantyne's Prizewinner, 25 tons 15 cwt. ; Bromley's Special, 20 tons 10 cwt.

The yields of the Intermediate and Long varieties were :—Weibull's Excelsior Red, 33 tons 15 cwt. ; Weibull's Cylinder Barres, 30 tons 5 cwt. ; Sutton's Red Intermediate, 29 tons 12½ cwt. ; Dickson's Improved Red Intermediate, 29 tons 5 cwt. ; Webb's New Lion Intermediate, 29 tons ; Weibull's Särimner, 27 tons 17½ cwts. ; Weibull's Red Yellow Barres, 27 tons 7½ cwt. ; Dickson's Peerless Intermediate, 26 tons 2½ cwt. ; Weibull's Light Sugar Red Top, 25 tons 5 cwt. ; Dickson and Robinson's Red King, 25 tons ; Little and Ballantyne's Eclipse Intermediate, 25 tons.

Manuring of Potatoes (*Rothamsted Expt. Sta., Ann. Rept. for* 1914 ; *E. J. Russell, D.Sc.*).—Nitrate of ammonia, at the rate of 80 lb. per acre, when applied to the crop, together with 12 tons of dung, 3 cwt. of superphosphate and 1¼ cwt. of muriate of potash, proved more effective than either 175 lb. of nitrolim or 220 lb. of nitrate of lime applied similarly.

Manuring for Hay (*Rothamsted Expt. Sta., Ann. Rept. for* 1914 ; *E. J. Russell, D.Sc.*).—On the average, for the years 1856 to 1912, the best results have been obtained by the use of the following manures, the respective yields of hay being given in cwt. per acre :—Complete mineral manure + extra ammonium salts + silicate of soda, 73·3 cwt. ; complete mineral manure + extra amm. salts, 66·5 cwt. ; complete mineral manure + nitrate of soda (= 86 lb. N.), 56·9 cwt. ; complete mineral manure + amm. salts, 54·3 cwt. ; mineral manure (without potash) + amm. salts, 47·7 cwt. ; complete mineral manure + nitrate of soda (= 43 lb. N.), 46·3 cwt. ; complete mineral manure, 40·9 cwt.

DAIRYING.

Machine Milking (*Kentucky Agric. Expt. Sta., Bull.* 186).—Experiments with the "Sharples Mechanical Milker" at this Station are described. The machine cost £120, and the cost of the power, which is furnished by an electric motor, has averaged about £1 per month. Very little difficulty has been experienced in operating the machine.

There was no appreciable or permanent decrease in milk production during the short period in which the cows were made accustomed to the machine. Of a herd of 50 cows the decline in the milk yield in March, April and May was less with 25 animals that were machine milked than with 25 that were hand milked, compared with the February

yields, all cows being hand milked in that month. The effect of discontinuing machine milking after seven months for a few days was that some few cows gained slightly, but that most decreased slightly in milk yield. The last milk is always hand stripped.

As a general rule it has been found that two men can milk and strip, and feed 28 cows and carry their milk to the dairy room in 44 minutes; exceptionally, one man alone has carried out these operations in 1 hour 14 minutes.

The most satisfactory solution for cleaning the parts of the machine has been found to be 10 lb. slaked lime (lump) in 9 gallons of water.

In this machine outside air is not drawn into the bucket, so that it is difficult for the milk to become contaminated unless the cups fall to the floor or unless the machine were improperly cleaned; and bacteriological tests have confirmed this, very low bacterial counts being obtained.

Experiments in Churning (*Jour. Roy. Agric. Soc.*, 1913 and 1914).—Experiments were carried out in 1913 and 1914 with the milk of different breeds of cattle. Four lots of milk, each of 2 gallons, were taken for each of the breeds, one lot being scalded and the other three lots being separated. Of these separated lots the cream of one was churned sweet within three hours after separation; the cream of the second was allowed to ripen naturally after being kept for 24 hours in 1913 and 48 hours in 1914 and then churned; while the cream of the third was ripened with a starter and churned after 24 hours.

The results were as follows:—

Breed.	Butter.							
	Ripened with Starter.		Ripened Naturally.		Scalded Cream.		Sweet Cream.	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
1913—								
Shorthorn	0	9¼	0	8¼	0	7¼	0	5
Holstein ..	0	9¼	0	8½	0	7¾	0	5½
Jersey	0	15¼	0	12¾	0	12¼	0	11¾
Dexter	0	10¼	0	11	0	8	0	9
1914—								
Shorthorn ..	0	10½	0	10¾	0	8	0	5½
Holstein ..	0	12½	0	12¼	0	10	0	7¼
Devon	0	13½	0	13¼	0	10¼	0	9½
Jersey	1	3¾	1	1	0	14¾	0	12¾
Guernsey ..	0	14	0	14¼	0	12¼	0	8½
Kerry	0	14½	0	14¾	0	10	0	9¾

LIVE STOCK AND FEEDING STUFFS.

Ricinus Poisoning (*Die Landw. Versuchs-Stat.*, Band lxxxv., Heft iii.-v.).—The following is a summary of a paper on poisoning by the seeds of the castor oil plant read by Kobert at the meeting of the Union of German Experiment Stations at the end of 1913.

There is only one species of Ricinus plant known to botany, viz., *Ricinus communis* L., but there are a number of varieties. All the varieties tested have proved poisonous, no matter what the size or colour of the seeds. The poison is contained in the shelled seeds and not in the shell, capsule, or oil extracted from the kernel. The substance

containing the poison is known as Ricin; it is not visible as such in the oil-free kernel; in quantity it forms only one per cent. of the dry, oil-extracted kernels. As, however, Ricin exceeds strychnine or arsenic in intensity, small quantities only of *Ricinus* seeds suffice to make a feeding stuff poisonous, a single gramme of the kernel mixed with several litres of milk having proved sufficient to poison a calf.

Castor oil seeds are introduced into feeding stuffs in various ways. In the first place the hedges of fields of ground-nut and sesame in the tropics are often of *Ricinus* plants and the seeds may thus get mixed with those of ground-nut or sesame at harvest. During transport, in storage, and in unloading there are again possibilities of castor oil seeds being mixed with other seeds. A further risk is run at the pressing factory where the machines may be badly cleaned after pressing the castor oil seeds, so that these become mixed with the next kind of seeds pressed. Again, for a soap making process in Germany the use of castor oil seeds is necessary, and there is the chance of their getting into animal foods owing to the amount of transport of these seeds that has to be carried on. Lastly, large quantities of the shells are sold at low prices to manufacturers of compound feeding-cakes who grind and use these shells in the cakes. As no method is known of completely freeing the shell from the kernel, it follows that these cakes must, as a rule, be poisonous, and on an average Kobert estimates that at least 1 per cent. of kernel matter will be present with the shell, an amount which is more than sufficient to cause fatal poisoning of cows when it is remembered that cakes are fed at the rate of from 2¼ up to 8¾ lb. per head per day. Farmers should refuse all such cakes, and merchants who resort to such practice are as guilty as if they included arsenic in their cakes.

The poison, Ricin, is an albumin and has the characteristics (1) of an albumin, (2) of a ferment or enzyme, (3) of a toxin, (4) of an agglutinin.

From the albumin nature of the poison it results that the mixture of Ricin with human or animal foods cannot be detected by purely chemical methods, even when one hundred times the fatal dose is contained in the foods; but the possibility of extracting the poison from foods by water or other method rests on the albumin nature of the poison.

The enzyme characteristics of the poison are useless for purposes of detection, since feeding cakes are always found to contain enzymes similar in effect to Ricin.

As regards its toxic effects immunity is reached by small, and gradually increasing, doses; and in the blood serum of immunised animals "antiricin," which has the effect of an antitoxin, is formed. This serum has been found extremely effective in the detection of extremely small quantities of ricin, but there is the drawback with this method that a different serum is produced in the case of some varieties.

The method of detection by injection into guinea-pigs and observing whether symptoms of super-sensitiveness are produced is not recommended by Kobert.

He lays stress, however, on the efficacy of a third method which rests on the agglutinin characteristics of the poison: *i.e.*, even if diluted to one millionth part of the original strength it coagulates the blood corpuscles of guinea pigs, and a substance like sealing wax is obtained on filtering. This method holds good for all varieties of *Ricinus* and is

even more sensitive than the serum test. Even here it must be remembered that "phasins" give a similar reaction. Ricin, however, *will* stand a temperature of 70°—75° C., while the only phasins that can be subjected to this temperature without being denatured are those present in *Phaseolus communis* and related indigenous legumes, and to detect these from ricin toxicological methods must be employed, *e.g.*, subcutaneous injections with rabbits.

The paper concludes with elaborate directions as to the conduct of tests for the detection of ricin in feeding stuffs.

Calf Rearing (*Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*)—This experiment on the best way of rearing calves from birth was begun at the Woburn farm in the spring of 1912. An interim report on the experiment was summarised in this *Journal* for June, 1913, p.240, but the chief particulars are again given below together with an account of the final results.

Twenty bull calves (Shorthorns) were selected and purchased in the open market at the end of March, 1912, when they were two to three days old. They were all fed with whole milk *only* for the first three weeks, taking on the average one gallon per head daily. They were then divided into five lots, in order to test different foods. This part of the experiment lasted for nine weeks; the foods tested and the results were as follows:—

Food.	Cost per Calf per Week.	Gain per Calf per Week.	Cost per lb. Gain in Live Weight.
	s. d.	lb.	d.
1. *Cod-liver oil* and separated milk* ..	2 8·19	9·66	3·33
2. *Calf meal* (purchased) with whole and separated milk	2 0	8·66	2·77
3. *Gruel* (6 lb. fine oatmeal and 1 lb. linseed to 1 gall. water) and separated milk*	2 4·77	8·33	3·45
4. *Whole Milk*	5 9·22	12·83	5·39
5. *Crushed oats* (given dry) and separated milk*	2 9·61	13·30	2·52

* The separated milk was substituted gradually for the whole milk of the preliminary three weeks' feeding, the change being completed in three further weeks.

The crushed oats thus gave the highest gain in live weight and at the lowest cost per lb. of increase. The whole milk gave the next highest gain, but at a much increased cost.

The calves were next, at the age of twelve weeks, turned out into the yard and all fed alike with separated milk, a little linseed cake and crushed oats. On 14th July milk was discontinued and on 18th July the calves were turned out to run in the fields, being given linseed cake, crushed oats and hay. Throughout the winter of 1912-13 the calves were in the fields in the day-time and came into the yard at night when they had linseed cake with a little cotton cake, hay and sliced roots. During the spring, summer and early autumn of 1913 the bullocks were run out on the pastures and on 6th November, 1913, they were once more put up in the yards for fattening off. For the entire period from the close of the nine weeks of special feeding the animals were all treated exactly

alike and received the same foods; consequently such differences as were observable may fairly be attributed to the early feeding.

As they became fit for the butcher (viz., between February and May, 1914) the bullocks were sent off to be killed. The average gains per head daily in live weight during the several periods were as follows:—

Food.	16 April to 18 June, 1912.	18 June to 17 Sept., 1912.	17 Sept., 1912, to 5 Feb., 1913.	5 Feb. to 6 Nov., 1913.	6 Nov., 1913, to close.	Whole period.
	lb.	lb.	lb.	lb.	lb.	lb.
1. Cod-liver oil..	1·38	1·90	1·63	1·36	2·00	1·63
2. Calf meal ..	1·24	1·75	1·53	1·29	1·58	1·40
3. Gruel.. ..	1·19	1·57	2·01	1·30	1·68	1·55
4. Whole milk ..	1·83	2·00	1·90	1·37	1·72	1·66
5. Crushed oats	1·90	2·19	1·90	1·37	2·70	1·85

It is clear that the advantage gained in the early stages by feeding with crushed oats and separated milk, and similarly with whole milk alone, was never afterwards lost; and the important point is brought out that the early feeding has a most marked bearing on the after-development of the animal. The crushed oats animals were earliest to mature, followed by the whole milk and cod-liver oil lots.

The cost of feeding per head in each lot during the whole period, and the gain per head after selling were as follows:—

Food.	Special feeding from commencement including whole milk.	Subsequent feeding and grazing.	Total cost, reckoning cost of calf at £2 6s. od.	Price realised at 5s. per 8 lb. stone.	Gain.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1. Cod-liver oil	1 16 8	7 15 4	11 18 0	20 10 4	8 12 4
2. Calf meal ..	1 10 6	10 3 4	13 19 10	20 15 4	6 15 6
3. Gruel ..	1 14 1½	9 18 11½	13 19 1	21 1 3	7 2 2
4. Whole milk	3 4 5	8 6 6	13 16 11	21 13 1	7 16 2
5. Crushed oats	1 17 9	8 2 9	12 6 6	23 0 5	10 13 11

This table again shows the marked superiority of the "crushed oats" feeding, the highest price and the highest gain being obtained with this food. The "whole milk" fed animals realised the second highest price, but the cost of feeding was greater, and the "cod-liver oil" lot stood second as regards final money returns.

Manurial and Feeding Value of Some Common Weeds (*Landw. Versuchs-Stat.* Band lxxxv., Heft vi.).—The composition of six weeds, viz., Bindweed (*Convolvulus arvensis*), Goosefoot (*Chenopodium album*), Chickweed (*Stellaria media*), Field Thistle (*Cirsium arvense*), Annual Sow Thistle (*Sonchus oleraceus*), and Annual Mercury (*Mercurialis annua*) was investigated. It is clear that these weeds abstract large quantities of plant nutrients from the soil; in their dry matter were found 2·77–4·45 per cent. of nitrogen, 0·85–2·01 per cent. of phosphoric acid, 4·91–11·78 per cent. of potash and 1·03–5·30 per cent. of

lime. Care must, therefore, be taken that these nutrients are not lost but placed at the disposal of cultivated plants. Weeds are best combated by hoeing.

Where it is not possible to keep down weeds, there is nothing to prevent their being used as feeding stuffs, provided that only those weeds are fed which are known to have good effects. For this purpose the plants must not be cut too near the ground, or too much earth will get into the food.

All the weeds examined, except Annual Mercury, have proved good as green fodder, and not the slightest harm has resulted from feeding them, especially to dairy cows. Bindweed had the highest feeding value. In the fresh condition these weeds did not attain the feeding value of red clover and lucerne; but in the dry condition they had a higher value than these two plants. Care should be taken that they are fed before they reach the seeding stage.

Annual Mercury is not readily eaten by animals, and injuriously affects their health, so that in spite of its high nutritive value it should, if possible, be excluded and used as manure.

In view of their content of plant nutrients, all the above weeds might be put to manurial use; but they should not be so used after they reach the seeding stage.

Effect of Storage on the Composition and Digestibility of Hay (*Landw. Versuchs-Stat.*, Band 84, 1914).—The investigations referred to the composition and digestibility of meadow hay kept for three years and of clover hay kept for two years in well ventilated storage; no changes were found to result in either composition or digestibility as a result of the storage. It is thought by the experimenters that the depreciation in hay on storage shown by other investigators must have been due to mechanical losses.

WEEDS AND PLANT PESTS.

Celery Leaf-spot (*Jour. Roy. Hort. Soc.*, April, 1915; *G. H. Pethybridge, B.Sc., Ph.D.*).—It is stated that there is little doubt that the spread of this disease has occurred mainly through the employment of infected celery seed.

To combat the disease three methods must be employed: (1) All celery seeds should be examined by a competent mycologist, and if necessary they should be treated with an appropriate germicide (see this *Journal*, July, 1914, p. 342). The onus of providing disease-free seed should be placed on the seed grower. (2) If the disease appears it should be kept in check by spraying the plants with Bordeaux mixture, in a somewhat similar manner to that adopted for checking potato blight (see Leaflet 238). (3) All diseased portions of the plants should be most carefully collected and burned, and in no circumstances should they be allowed to remain in or on the soil, or to reach the manure or compost heap.

A disease discovered on wild celery seemed to be identical with leaf-spot of cultivated celery, and it is thought that the original source of the disease is to be looked for in the parasite occurring on the wild plant.

Iris Leaf-blotch Disease (*Jour. Roy. Hort. Soc.*, April, 1915; *J. K. Ramsbottom*).—This disease (*Heterosporium gracile*) occurs on many

different species. The affected leaf fades much before the normal time, and, apart from an unsightly appearance resulting, the storage of food reserves for the next season's growth is hindered.

The fungus can pass through the winter in its fruiting form, and the spores are capable of germination even after 24° F. of frost; the other parts of the fungus are capable of regeneration and thus of forming a new centre for the spread of the disease.

All old leaves should be gathered and burned. A dressing of slaked lime put on in autumn and lightly forked in in spring has been found efficacious in eradicating the disease. Further, it would seem that the disease particularly affects lime-loving species when the soil is deficient in lime, but not lime-hating species.

Successful attempts were made to inoculate living plants with cultures of the spores. An attempt to inoculate Narcissus failed.

Wart Disease of Potatoes (*Third Rept. of Bd. of Agric. for Scotland*).—The varieties Isis, Irish Queen, and Great Scot were found to be resistant to wart disease in experiments in sixteen severely infected gardens. In every instance the variety Up-to-Date was severely attacked by the disease.

Salt, formalin and calcium carbide, applied to the soil a short time before the potatoes were planted, each considerably reduced the yield of the crop with no corresponding diminution of wart disease.

American Gooseberry Mildew (*Third Rept. of Bd. of Agric. for Scotland*).—It is stated that, judging by the observations carried out by the Inspectors of the Board of Agriculture for Scotland, there can be little question that spraying during the period of growth, followed by careful pruning and burning of all diseased wood as soon as growth has ceased for the season is a more effective method of controlling the disease than summer tipping without spraying.

MISCELLANEOUS.

Germination Test for Seeds (*Abs. in Jour. of Ecology*, March, 1915).—A method different from that ordinarily in use for testing vitality of seeds is required when a considerable period elapses before conditions favourable to germination occur; and in this investigation differences in the amounts of heat liberated by seeds were used for estimating age and germinating capacity. The heat given off and the germinating capacity decrease with increasing age; and the younger seeds respond most quickly to the influence of conditions favourable to germination, reaching the maximum percentage of germination and the maximum temperature sooner than older seeds. Germinating seeds have "characteristic" temperatures; and if the seed under test has a temperature removed from the characteristic temperature for the species, and if within a reasonable time (varying with the species) there is no rise in temperature or a rise which does not indicate the characteristic temperature, then the seed will not germinate.

Natural and Artificial Drying of Grass (*Landw. Versuchs-Stat.*, Band LXXXVI., Heft III. und IV.; *F. Honcamp*).—The common method of drying grass into hay in the open, and by exposure to the sun, was found to lead to loss of crude and digestible nutrients in the grass, quite apart from mechanical losses. All the nutrients were affected, but the loss occurred especially in the fat, both as regards absolute amount, and digestibility.

On the other hand, with proper precautions, and at low temperatures, it was found that artificial drying of the grass did not lead to any significant loss either of crude or digestible nutrients. Artificial drying of grass by hot gases as carried out in the ordinary drying apparatus in use in Germany was, however, always found to lead to a considerable decrease in the digestibility of the protein.

NOTES ON AGRICULTURAL CO-OPERATION.

The Land and Agricultural Bank of South Africa.*

THE Land and Agricultural Bank of South Africa was established by an Act of the Union Parliament, and came into existence on 1st October, 1912, on which date it took over the assets and liabilities of the Transvaal Land Bank and the Agricultural Loan Funds of the Orange Free State and Natal.

The main object of the Bank is "to assist the farming population by providing, *bona fide* and deserving applicants with funds at a cheap rate, repayable in instalments over an extended period."

The control of the Bank is in the hands of a Central Board, with offices at Pretoria. This Central Board deals directly with the business of the Transvaal area, while local boards have been established for Natal, the Orange Free State, Eastern Cape Colony, and Western Cape Colony.

The magistrates of the Union are the agents of the Bank, which is largely dependent upon them, on the one hand, for information as to the character of each applicant for a loan, and the value of the security offered, and, on the other hand, for making known to the farmers the various kinds of advances which the Bank is authorised to make.

The minimum amount which may be lent to any one farmer is £50, and the maximum amount ordinarily £2,000, and exceptionally £5,000.

Each application for an advance must be accompanied by a valuation of the property offered as security, made by a valuer appointed by the Central Board; the cost of making the valuation is regulated by a scale of charges and falls upon the applicant. The security for loans is normally a first mortgage on land or farm buildings, and advances may be made up to 60 per cent. of the value of the security offered.

The advances are made for thirty years; during the first five years interest is paid at the rate of 5 per cent., and the borrower has the privilege of reducing the amount of the loan by repayments of £5, or any multiple of such sum, at any date upon which interest is due. At the end of five years the principal sum outstanding becomes repayable in twenty-five years in half-yearly instalments.

Besides the above "ordinary" loans, the following (among other) "extraordinary" advances may be made: (1) Cash credits to farmers for short periods for an amount not exceeding £1,000; (2) Advances for the construction of fences and dipping tanks; and (3) Advances to approved co-operative societies.

* Summarised from the *Monthly Bulletin of Economic and Social Intelligence*, International Institute of Agriculture, October, 1914, and April, 1915.

The last-named advances are guaranteed by the joint and several liability of all the members, while, as an additional security, the Bank has power to inspect the books of the society for the purpose of ascertaining whether the funds advanced are being carefully and economically expended for the proper purposes.

These purposes are especially :—

(1) The erection of buildings and the purchase of

(*a*) Immovable property.

(*b*) Agricultural machinery to be worked on behalf of members.

(*c*) Breeding stock to be controlled and used on behalf of members.

(*d*) Plant, office furniture, and other equipment.

(2) To make advances to members against produce, actually delivered to a society in good order and condition, and carefully graded.

(3) To purchase grain bags, agricultural implements, seeds, and farming requisites to be supplied to members.

Operations from 1st October, 1912, *to 31st December,* 1912.—In this period the number of applications for ordinary advances, which were approved, was 547, to the amonnt of £348,220 ; the number of advances actually paid out was 287, to the amount of £106,840 (*i.e.*, £372 on the average), and secured by farm property to the value of £265,521. The purposes for which these advances were made were : For improvements, £20,124 ; for purchase of stock, £14,622 ; for discharge of existing liabilities, £49,142 ; for sub-division of land, £172 ; and for purchase of land, £22,780.

The profit made by the Bank in the period was £8,674, which, added to the reserve funds taken over from the Transvaal Land Bank and the Land and Agricultural Loan Funds of the Orange Free State and Natal, brought the reserve fund of the Bank at the end of 1912 to £88,160.

Operations during 1913.—The demand during 1913 for the benefits offered by the Bank was so much beyond expectations that the funds placed at the disposal of the Central Board proved quite inadequate, and the Board could only continue to make advances after securing a large overdraft from its bankers, and an additional grant of £25,000 from the Government. The issue of stricter regulations as to the purposes for which loans could be granted failed to lessen the rate at which applications for advances increased, and the maximum amount of loans was, therefore, reduced to £500.

The Board estimated that it would require a further vote of £439,000 for the year ending 31st March, 1914, and one of £1,435,000 for the year ending 31st March, 1915, unless the maximum amount of the loan of £2,000 were permanently lowered, and it was loath to advocate this way out of the difficulty, as any such reduction would defeat the purposes for which the Bank was created.

During 1913, 2,636 " ordinary " advances were made to the amount of £1,530,060 (average £584), and against security of the value of £3,418,670. The purposes for which the loans were granted were for : Improvements, £216,270 ; purchase of stock, £125,335 ; discharge of existing liabilities, £662,118 ; and purchase of land, £525,972.

Of the " extraordinary " advances £60,246 was granted in respect of dipping tanks (though not paid out in full), £102,195 was paid for fencing construction, and advances of £55,000 were made to three co-operative societies.

THE history and working of a successful fruit growers' association in Kansas is given in the *Report of the Kansas State Board of Agriculture* for 1913–14.

A Successful American Fruit Growers' Association.

Previous to the formation of the Association fruit growing in the district (Wathena) had become unremunerative owing mainly to the irregularity with which the supplies of fruit were despatched; on one day many growers would pick and the produce would have to be despatched on account of its perishability and the market would be glutted; while on other occasions during the season orders could not be carried out because so little fruit was picked.

A meeting of 150 growers which discussed the problem decided that the organisation of the whole of their supplies would be too difficult a task. Twelve of these growers, however, proceeded to organise themselves into the "Wathena Fruit Growers' Association" by subscribing capital to the value of £250 in twelve equal shares. The first year was a success, and the efforts of some firms in the fruit trade to "break" the Association failed.

At present, after nine years' work, the Association numbers 150 members. Every person desirous of becoming a member must be a fruit grower, must contribute a membership fee of £2 2*s*. and buy at least one share of £1 1*s*., each share carrying one vote. The Association's property, consisting of warehouses, forwarding sheds and office, is valued at £4,170; the warehouses are near the railway yards and are equipped with the best forwarding facilities.

There are no restrictions imposed on the growers in regard to their methods of cultivation; but all fruit must be packed in the fields, and all (except apples) must be delivered to the Association in spring waggons. To induce the growers to bring in their fruit early in the day a reduction in price is made on fruit delivered late. All the produce is inspected and any not coming up to standard rejected; there is only one grade of fruit, the standard being high. When the fruit has been passed by the inspector the stamp of the Association is put on it and the grower is given a ticket, showing the kind, quantity and value of the fruit, and which, when presented at the office of the Association, entitles the grower to the amount shown thereon. The price paid varies from day to day, and is the price paid to growers by firms in the fruit trade.

At the end of the year the profit or loss in marketing is pro-rated among the members according to the amount of fruit forwarded through the Association. The accounts of each kind of fruit are kept separate; for instance, strawberries bear their own losses or profits.

While members cannot be compelled to market all their fruit through the Association, on account of the anti-trust laws, they are morally bound to do so, and there are few, if any, who do not. Rarely is any difficulty experienced in disposing of the produce. The Association enjoys a wide reputation, despite the fact that the only advertising done is the despatch of circular letters or post cards to regular customers quoting prices for the fruit being marketed.

Very little fruit is consigned, most of it being sold by wire, f.o.r. on the railway waggon at Wathena. Any losses during transit of waggon-load lots are made good by the Association and recovered from the railway or other forwarding company. The distribution of the fruit to the various markets is not a matter of much importance to the Association as it is principally the business of the firms who are the

customers of the Association. A close scrutiny of prices all over the country is made by the manager of the Association in order to secure the marketing of the fruit to the best possible advantage. The annual business of the Association is possibly of the value of £60,000.

All materials for making crates and preparing sprays are bought through the Association at a saving of about 20 per cent. Post cards are sent to each member requesting that he inform the manager of the number of crates, baskets and barrels he will need. The amounts are summarised and all the manufacturers of such material are asked for bids for the whole for December or January delivery. It is estimated that, compared with a neighbouring horticultual society, the members of this Association have saved £4,200 in seven years on the purchase of this material.

As regards staff, the manager is employed throughout the year at a stated salary. In addition, the Association engages additional help during the forwarding season (May to November) consisting of two bookkeepers, one forwarding clerk, one inspector and an assistant. The total sales and office expenses amount to about £730 a year on the average.

Co-operative Agricultural Credit in the Punjab.

ARTICLES on co-operative agricultural credit in India as a whole have appeared in this *Journal* for February 1913, p. 947, and January 1914, p. 922. An account of the movement dealing with the Punjab only, and going into some detail, is contributed by Sir James Douie, K.C.S.I., to the June, 1915, issue of *Co-operation*.

It is pointed out that the Punjab is as large as England, Scotland and Wales, has a population of twenty million souls, and is an agricultural country mainly owned, and to a large extent cultivated, by small peasant landowners. In the plains an average sized holding occupies an area of six or seven acres. Village banks were started ten years ago as one means of counteracting the great, and at that time growing, evil of agricultural debt.

The following figures show how remarkable has been the progress made :—

Year.		Societies.	Members.	Working Capital.
				£
1905-6	..	23	1,203	2,840
1906-7	..	177	17,533	20,127
1907-8	..	258	21,881	30,081
1908-9	..	316	23,429	59,436
1909-10	..	706	38,604	124,200
1910-11	..	1,088	61,423	245,673
1911-12	..	1,769	93,169	488,128
1912-13	..	2,845	133,780	720,627
1913-14	..	3,333	160,892	1,228,660

A proof of the solidity of the foundations on which the movement rests is shown by the fact that it was very little affected by a financial crisis among joint stock banks in towns in 1913-14, when many of the latter closed their doors.

Of the societies shown in the above statement 38 with a working capital of £284,662 are either Central Banks (18) or Unions (20) whose chief business is the financing of village banks. As the former develop, the latter will probably cease to advance money, and confine themselves

to the business of inspection and control. Only village societies can hold shares in Unions. The older Central Banks pay dividends of from 6 to 12 per cent. They pay 6 per cent. interest on deposits, and charge 8 per cent. on loans to societies. They received during the year 1913-14 £103,659 in deposits as against £67,042 withdrawn. The Unions are in many cases partly financed by the Bank of Bengal.

The deposit business of the 3,261 agricultural village banks was somewhat affected by the financial crisis. There was a shrinkage in receipts and a large increase in withdrawals, as the following figures prove :—

	1912-13.	1913-14.
	£	£
Received	162,622	121,441
Withdrawals ..	70,613	106,210

The usual rate of interest on deposits is 6 per cent. Members pay 12½ per cent. interest on loans, but it must be remembered that a man who had to pay the moneylender 18, 24, or 36 per cent. is glad to get money on such comparatively easy terms. The societies have share capital, but at present no dividends are payable, and it is hoped that this restriction will become permanent, or at any rate will be maintained till the growth of working capital enables them to lower the rate of interest on loans. £480,381 were advanced to members and £40,813 to other societies during the year.

Each village society now consists on the average of 47 members. The actual funds of which they have the handling are estimated at £776,666, made up of

	Per Cent.
Share Capital	27
Interest received	8
Deposits by Members	15
Loans and Deposits by Non-members ..	16½
Loans from Central Societies	33
Loans from Government	½

Thus half of the working capital is supplied by the members themselves, and the Government's share in financing the societies, which becomes less year by year, is now a negligible quantity.

A rough classification of the purposes for which loans are taken, compiled from figures supplied by 14 districts, may be of interest.

	Per Cent.
Payment of Land Revenue	21
Purchase of Cattle	20
Payment of Debts and Mortgages	17
Household Expenses	16
Purchase of Seed and Fodder	15
Other purposes	13

In the single district of Jalandhar, where the village bank has become an exceedingly popular institution, £65,121 have been advanced since the movement started, to pay off unsecured debts, and £24,360 to release from mortgage 5,450 acres of land.

The profit earned during the year 1913-14 was £41,038, which amounts to 20 per cent. on the share capital, but, as already noted, no dividends are at present paid. The management expenses were only £1,243.

The Government has made itself responsible for audit and inspection. Given the local conditions this was, and will probably long continue to be, a condition of successful working. The discreditable history of many of the joint stock town banks in India has shown that State

supervision, and help to organise new societies, is essential. But the cost of the inspecting staff is being met more and more by the societies themselves, and the expenditure on the Government-paid staff, exclusive of the Registrar and Assistant Registrar, who are members of the Indian Civil Service, only works out at sixteen shillings per society.

Suggestions from America for Co-operative Selling.

IN connection with the article on this subject, which was published in this *Journal* for June, 1915, p. 201, it should have been acknowledged that the illustrations of specimens of American brands (Fig. 3) were reproduced from *The Country Gentleman* (Philadelphia, U.S.A.) with the kind permission of the editor of that Journal.

Monographs on Agricultural Co-operation. Vol. II.

THE International Institute of Agriculture has issued Vol. II. of its series of Monographs on Agricultural Co-operation in various countries. This volume deals with Argentina, Austria, Hungary, Italy, and Switzerland. The Board have made arrangements to supply copies (in English) of this publication at the price of 2*s*. 9*d*. each post free. Applications, with remittances, should be addressed to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

OFFICIAL NOTICES AND CIRCULARS.

Slaughter of Animals Order of 1915.

THE Board of Agriculture and Fisheries have, under the Slaughter of Animals Order of 1915 (dated 22nd June, 1915), prohibited the slaughter of

(*a*) Animals which are visibly or obviously in-calf or in-pig; and

(*b*) Calves under the age of twelve weeks, except male calves of Channel Island, Ayrshire and Kerry breeds.

The restrictions do not apply to

(*a*) Slaughter of an animal under the powers conferred by the Diseases of Animals Acts, 1894 to 1914, or any Order made thereunder; or

(*b*) Slaughter of an animal necessary or desirable on account of accidental injury to the animal or its illness; or

(*c*) Slaughter of an animal if in the opinion of the Board of Agriculture and Fisheries the slaughter is desirable for any exceptional reason or purpose and the slaughter is authorised by a licence granted by that Board or an officer of that Board.

Any contravention or failure to comply with the Order renders the offender liable to a fine of twenty pounds, or if the offence relates to more than four animals to a fine of five pounds for each animal.

Committee on Home Production of Food.

THE President of the Board of Agriculture and Fisheries appointed on 17th June a Departmental Committee to consider and report what steps should be taken by legislation or otherwise for the sole purpose of maintaining and, if possible, increasing the present production of food in England and Wales, on the assumption that the war may be prolonged beyond the harvest of 1916. The Committee is constituted as follows :—

The Rt. Hon. Viscount Milner, G.C.B., G.C.M.G. (*Chairman*).
The Lord Inchcape, G.C.M.G., K.C.S.I.
The Rt. Hon. Francis D. Acland, M.P.
Mr. Charles W. Fielding.
Mr. A. D. Hall, M.A., F.R.S.
Mr. Rowland E. Prothero, M.P.
Mr. J. A. Seddon.
The Hon. E. G. Strutt, and
Sir Harry C. W. Verney, Bart., M.P.

The Secretary of the Committee is Mr. H. L. French, of the Board of Agriculture and Fisheries, to whom all communications should be sent.

The Committee has been appointed for the specific purpose defined in its terms of reference, and it has been asked, should it find that additional powers are necessary, to report in time for legislation to be submitted to Parliament during the present Session. Its functions are quite distinct from those of the Agricultural Consultative Committee appointed by Lord Lucas on the outbreak of war. The Consultative Committee is a permanent Committee to which the Board refer many subjects connected with practical agriculture, and no alteration in its work or constitution is contemplated; it will continue to advise the Board throughout the duration of the war.

Consumption of Old Potatoes.

THE President of the Board of Agriculture and Fisheries desires to call attention to the fact that there is a considerable supply of last year's crop of potatoes remaining unconsumed. At this season there is a general demand for new potatoes, and these, although they are undersized because of the dry weather, are already being disposed of in great quantities. This is a waste of the national resources, since most of the new potatoes if left in the ground would increase considerably in weight. Consumers are therefore urged to make use of the remainder of last year's potato crop before making large demands upon the new one.

Employment of Soldiers for Hay-making.

THE Board of Agriculture and Fisheries were informed by the Army Council early in June that in view of the possible shortage of agricultural labour for the hay harvest, furlough will be given, at the discretion of the Military Authorities, to a limited number of soldiers of the New Armies and of the Territorial Force for work in the hay harvest as circumstances may permit.

The furlough granted to each soldier will last only for such number of days, not exceeding fourteen, as he is actually required for hay-making.

The employment of soldiers in the hay harvest will be subject to the following conditions:—

1. That suitable labour cannot be obtained in the locality.
2. That the farmer will undertake to pay each soldier sent at his request:—
   (*a*) 4*s*. a day if the soldier provides his own board and lodging.
   (*b*) 2*s*. 6*d*. a day if board and lodging is provided by the farmer.
3. That the farmer will provide conveyance from and to the nearest railway station.

No charge will be made to the farmer for railway travelling expenses.

Every endeavour will be made to ensure that the men released have been accustomed to farm work, but no guarantee to this effect can be given.

The above arrangements will not apply to the corn harvest, in respect of which fresh regulations will be issued.

Applications from farmers who desire to employ soldiers in the hay harvest must be made as soon as possible to the Board of Trade Labour Exchanges, when the application will be transmitted to the Military Authorities. Forms for the purpose are obtainable from the Local Labour Exchange, the address of which can be obtained from the nearest Post Office.

Indian Wheat Committee: Reappointment.

THE President of the Board of Agriculture and Fisheries has re-appointed, as follows, the Indian Wheat Committee, appointed by his predecessor, to supervise the arrangements in this country connected with the scheme introduced by a notification of the Government of India, dated 25th March, 1915, for the shipment of wheat from India to the United Kingdom on Government account.

The Rt. Hon. F. D. Acland, M.P. (Parliamentary Secretary to the Board of Agriculture and Fisheries) (*Chairman*).

Mr. R. H. Rew, C.B. (Board of Agriculture and Fisheries) (*Deputy-Chairman*).

Mr. J. M. Keynes (H.M. Treasury).

Sir George Saltmarsh (The Baltic).

Sir Lionel Abrahams, K.C.B. (India Office).

Mr. T. H. Middleton, C.B. (Board of Agriculture and Fisheries).

Mr. J. A. Hubback (India Office).

Mr. H. D. Vigor (Board of Agriculture and Fisheries) (*Secretary*).

Ensilage: Special Notice to Farmers.

THE prolonged spell of dry weather has affected both the hay and root crops, and in view of the reduction in yield and the increased demand for hay and fodder next winter the Board of Agriculture and Fisheries wish to draw the attention of farmers to ensilage. This system of storing fodder in the green state is well known, and silage has an established reputation as a food for stock; but under present circumstances it has two special advantages. Ensilage affords a safeguard against waste should the autumn prove too wet for harvesting late hay crops, and it provides, in silage, a form of green food which makes a very good substitute for roots.

In many cases hay aftermath might be converted into silage. When the aftermath is grassy a top dressing of ¾ cwt. sulphate of ammonia or other quick acting nitrogenous manure would be useful. It is not too late to sow crops for silage purposes in July and August. A mixture such as vetches, oats, and a little rape would make good silage, and prove an effective "smother" crop if sown early in July on land where roots may have failed because of drought. If the stubbles are broken up as soon as the corn is in stock and sown with white mustard or rape useful crops for filling the silo may be expected.

The main essential in making silage is compression, to exclude air, and this object is usually best attained when the silage crops are cut while still in the immature condition and carted soon afterwards.

Silage is now generally made in Stave Silos or in stacks. The ... United States has been successfully

and needs no artificial weighting; the fodder is chaffed before being stored, and the greater depth of the silo as compared with its diameter ensures sufficient compression. On the other hand, a stack saves the initial cost of a silo, and may be erected in any convenient position. Full particulars as to the making of silage will be found in Leaflet No. 9 (*Ensilage*), copies of which may be obtained free of charge, and post free, on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Letters or post cards of application so addressed need not be stamped.

Leaflets in 1915.

SINCE the date of the list given on p. 951 of the *Journal* for January last the following leaflets have been issued in the ordinary series:—

No. 282.—*Schemes for Improvement of Live Stock*; and

No. 290.—*The Cattle Testing Station of the Board of Agriculture and Fisheries.*

In addition, the information given in the following leaflets has been revised and brought up to date:—

No. 4. *Winter Moths.*—The section "methods of control" has been completely revised.

No. 30. *Codling Moth.*—This leaflet has been entirely re-written, and brought up to date.

No. 44. *The Lapwing, Green Plover, or Peewit.*—The leaflet has been re-written, and a table added showing the times of the year during which the eggs of the lapwing are protected in different counties and boroughs.

No. 75. *Root-knot Disease of Cucumbers and Tomatoes.*

No. 96. *Milk Fever or Parturient Apoplexy.*

No. 170. *The Use of Lime in Agriculture.*—This leaflet has been considerably revised. Attention is now drawn to the value of ground limestone as a source of lime.

No. 179. *The Making of Soft and Cream Cheeses and Clotted Cream.*

No. 208. *Larch Shoot Moths.*—This leaflet has been re-written.

No. 244. *The Destruction of Rats.*

Sheep Grazing on Golf Links.

WITH reference to the note published in this *Journal* for May, 1915, p. 177, containing a suggestion by the Acting Secretary of the Sunningdale Golf Club to the effect that many of the golf links in this country might be more extensively employed for grazing sheep, it is satisfactory to note that, out of some hundred communications on the subject addressed by golf clubs to the Board, in the vast majority of cases it was stated that the grazing was already let for sheep (or even cows and ponies) and that in practically every case where the land was not so let, arrangements were being made for the purpose. In several cases the Board were informed that the grass on the links was cut for hay.

Produce of Crops in England and Wales, 1914.

PART II. of the Agricultural Statistics for 1914 (Cd. 7954, price 3½*d.*) giving returns of the produce of crops in England and Wales in 1914, with summaries for the United Kingdom, has been recently issued by the Board. An interesting feature is the inclusion of a summary of reports received from the Board's crop reporters on the conditions affecting crops and live stock, and the course of farming operations during the "harvest" year 1913-14 in each group of counties in England

Report of the Commercial Control Branch for 1914.

THE Report for 1914 of the Commercial Control Branch of the Board of Agriculture and Fisheries [Cd. 7935, price 3*d.*] contains an account of the work accomplished during 1914 with regard to the administration of the Sale of Food and Drugs Acts, 1875-1907; the administration of the Fertilisers and Feeding Stuffs Act, 1906; prosecutions under the Merchandise Marks Acts, 1887 to 1894; and questions as to the transport and marketing of agricultural produce and the produce of any fishing industry.

MISCELLANEOUS NOTES.

The Increasing Wages of Agricultural Labourers.

FREQUENT reference to the increasing wages of agricultural labourers has been made in past issues of this *Journal*, but in view of the interest of the question at the present time no apology is needed for again alluding to the subject.

The note in this *Journal* for November, 1914, p. 759, gave particulars of the movement of agricultural wages in 1913. The Board of Trade have now obtained returns (*Board of Trade Labour Gazette*, June, 1915) showing the changes which took place in the rates of cash wages in 1914, and also changes made this year up to the latter part of April. The returns cover over 90 per cent. of the rural districts.

Changes in 1914.—The results obtained by combining the changes in wages in 1914 with the estimated total number of agricultural labourers of all classes in the rural districts affected are shown in the following table, comparative figures being added for each year from 1896, the earliest year for which statistics have been compiled:—

Year.	Estimated Number of Men affected.			Computed amount of Change in Weekly Cash Wages, comparing each Year with the previous Year.		
	By Increases.	By Decreases.	Total.	Increases.	Decreases.	Net Inc. (+) or Dec. (—).
				£	£	£
1896 ..	52,771	36,676	89,447	1,858	1,513	+ 345
1897 ..	72,559	4,340	76,899	2,232	110	+ 2,122
1898 ..	183,987	2,356	186,343	6,227	47	+ 6,180
1899 ..	163,960	208	164,168	5,438	4	+ 5,434
1900 ..	230,635	—	230,635	8,150	—	+ 8,150
1901 ..	127,565	10,469	138,034	3,559	398	+ 3,161
1902 ..	51,949	41,705	93,654	1,609	1,297	+ 312
1903 ..	51,095	24,953	76,048	1,449	893	+ 556
1904 ..	23,779	9,569	33,348	1,032	451	+ 581
1905 ..	6,659	12,438	19,097	252	442	— 190
1906 ..	14,758	8,744	23,502	704	322	+ 382
1907 ..	14,971	3,439	18,410	479	103	+ 376
1908 ..	40,134	13,780	53,914	1,411	684	+ 727
1909 ..	29,244	19,772	49,016	747	451	+ 296
1910 ..	15,451	271	15,722	794	22	+ 772
1911 ..	25,427	4,360	29,787	1,214	270	+ 944
1912 ..	102,602	1,846	104,448	5,383	92	+ 5,291
1913 ..	182,040	641	182,681	9,996	32	+ 9,964
1914 ..	242,047	—	242,047	19,337	—	+19,337

It will be seen that there was a very marked increase in wages in 1914, the aggregate weekly amount by which wages increased being nearly twice as large as in 1913, and equal to the accumulated net increase of the ten years 1904-13. The majority of the increases took place in the autumn (*i.e.*, after the outbreak of war), at which season the scarcity of labour previously existing became more or less accentuated in many districts, largely as the result of recruiting for the Army. No decreases in ordinary labourers' wages were reported.

The counties showing over 75 per cent. of the total number of labourers as being affected by advances in cash wages were Cumberland, Westmorland, East and West Ridings of Yorkshire, Leicestershire, Derbyshire, Gloucestershire, Shropshire, Northamptonshire, Huntingdonshire, Norfolk, Berkshire, Denbighshire, and Montgomeryshire.

The usual amount of increase in 1914 in rural districts in which advances took place varied from 1*s*. to 3*s*. per week, but in a number of rural districts some of the labourers received more than 3*s*. The increases were distributed as follows among the labourers estimated

Predominant Amount of Increase in Wages since July, 1914.

County.	Predominant limits of Increase in Wages up to April, 1915, since July, 1914.	County.	Predominant limits of Increase in Wages up to April, 1915, since July, 1914.
Northern Counties :—		South Midland and Eastern Counties—*continued.*	
Northumberland ..	1*s*. to 3*s*.	Suffolk	2*s*. to 3*s*.
Durham	1*s*. ,, 4*s*.	Norfolk	2*s*. ,, 3*s*.
Cumberland	1*s*. ,, 2*s*.	South Eastern Counties :—	
Westmorland ..	1*s*. ,, 2*s*.	Surrey	1*s*. ,, 2*s*.
Yorkshire, Lancashire and Cheshire :—		Kent	1*s*. ,, 3*s*.
Yorkshire	1*s*. ,, 4*s*.	Sussex	1*s*. ,, 3*s*.
Lancashire	1*s*. ,, 3*s*.	Hampshire	Up ,, 4*s*.
Cheshire	1*s*. ,, 3*s*.	Berkshire	2*s*. ,, 4*s*.
North and West Midland Counties :—		South Western Counties :—	
Leicestershire ..	1*s*. ,, 3*s*.	Wiltshire	2*s*. ,, 4*s*.
Rutland	About 1*s*.	Dorset	2*s*. ,, 3*s*.
Lincolnshire	1*s*. to 3*s*. 6*d*.	Devonshire	1*s*. ,, 3*s*.
Nottinghamshire ..	2*s*. to 3*s*.	Cornwall	1*s*. ,, 2*s*.
Derbyshire	2*s*. ,, 4*s*.	Somerset	1*s*. ,, 3*s*.
Gloucestershire ..	1*s*. ,, 2*s*.	Wales and Monmouthshire :—	
Herefordshire ..	2*s*. ,, 3*s*.	Flintshire	1*s*. ,, 3*s*.
Shropshire	2*s*. ,, 4*s*.	Denbighshire ..	1*s*. ,, 4*s*.
Staffordshire ..	1*s*. ,, 3*s*.	Carnarvonshire ..	Little change
Worcestershire ..	1*s*. ,, 2*s*.	Anglesey	1*s*. to 3*s*.
Warwickshire ..	1*s*. ,, 3*s*.	Merionethshire ..	About 2*s*.
South Midland and Eastern Counties :—		Montgomeryshire ..	About 2*s*.
Middlesex	2*s*. ,, 3*s*.	Cardiganshire ..	1*s*. to 2*s*.
Hertfordshire ..	1*s*. ,, 3*s*.	Radnorshire	1*s*. ,, 3*s*.
Buckinghamshire ..	1*s*. ,, 2*s*.	Brecknockshire ..	1*s*. ,, 3*s*.
Oxfordshire	1*s*. ,, 3*s*.	Carmarthenshire ..	1*s*. ,, 2*s*.
Northamptonshire ..	1*s*. ,, 3*s*.	Pembrokeshire ..	1*s*. ,, 2*s*.
Huntingdonshire ..	2*s*. ,, 3*s*.	Glamorganshire ..	2*s*. ,, 3*s*.
Bedfordshire ..	1*s*. ,, 2*s*.	Monmouthshire ..	1*s*. ,, 3*s*.
Cambridgeshire ..	2*s*. ,, 3*s*.		
Essex	[illegible]		

to have participated: in rural districts with 12,478 labourers the mean increase was 6*d.* or under per week; with 99,681 labourers, over 6*d.* and up to and including 1*s.*; with 97,737 labourers, over 1*s.* and up to 2*s.*; with 20,901 labourers, over 2*s.* and up to 3*s.*; and with 11,250 labourers, over 3*s.*

Changes since the Outbreak of War.—From the particulars, so far as reported, of increases granted this year, it is evident that the upward movement in agricultural wages is still continuing.

In the table on p. 375 is given for the various counties the predominant amount of increase in wages since July, 1914, in those rural districts in which wages have been reported as changed. As previously stated, returns have not been received from all rural districts, and in certain other districts no general change in wages has been made. In a few districts the amount of advance falls outside the limits stated for the county, but such cases are exceptional.

Production and Quality of Sulphate of Ammonia.

THE Report of the Chief Inspector of Alkali Works for 1914 (H. C. 253, 1915) shows that there were 624 works or separate processes for the manufacture of sulphate and muriate of ammonia in England and Wales in 1914, as compared with 595 in 1913, and 581 in 1912, the number having steadily increased from 449 in 1904. In Scotland the number of such works was 111. There were also 56 gas liquor works in England and Wales, and 8 in Scotland.

The quantity of sulphate of ammonia produced in the United Kingdom in 1914 is shown in the following table:—

Source.	1914.	1913.	1912.
	Tons.	Tons.	Tons.
Gas works	175,930	182,180	172,094
Iron works	16,008	19,956	17,026
Shale works	62,749	63,061	62,207
Coke oven works	137,430	133,816	104,932
Producer-gas and carbonising works (bone and coal)	34,295	33,605	32,049
Total	426,412	432,618	388,308

The disturbing influence of the war affected the production of most of these different groups of works in 1914.

The standard quality of British sulphate of ammonia has been the subject of discussion, some of the sulphate produced in this country prior to the war being said by foreign consumers to compare unfavourably, to a marked degree, with the product received from Germany. The Sulphate of Ammonia Association has, it is stated, issued directions as to the conditions best calculated to ensure a satisfactory product, but there is wide room for enquiry and research on the question of the manufacture of sulphate of ammonia with the object of getting the best product at low costs.

The question of efficient production is one which is likely to become more prominent as advance is made in the domain of synthetic nitrogenous fertiliser products with attendant reduced costs, increased production, and more severe competition; and centralised effort [illegible] associations and most

The exports of sulphate of ammonia in 1914 amounted to 314,000 tons as compared with an estimated home consumption (for all purposes, including manure manufacture) of 106,000 tons. The corresponding figures for 1913 were 325,000 tons and 97,000 tons respectively.

In the table below are shown the imports of the materials used in the fertiliser trade, the principal being mineral phosphates. A proportion of the nitrate of soda imported is used in the manufacture of sulphuric and nitric acids:—

——	1914.	1913.	1912.
	Tons.	Tons.	Tons.
Guano	39,285	25,548	14,115
Mineral phosphates	555,605	539,016	520,270
Nitrate of soda	171,910	140,926	123,580

The number of chemical manure works under inspection in 1914 was 183 as compared with 217 in 1901.

International Institute of Agriculture: Bulletin of Agricultural and Commercial Statistics.

THE June number of the Bulletin of Agricultural and Commercial Statistics, published by the International Institute of Agriculture, contains the most recent information received at the Institute on cereal crops in the Northern Hemisphere. Forecasts are given for certain countries where the harvest is already in progress or will soon be commencing. Crop conditions in the various countries may be seen in the Bulletin itself.

The Bulletin contains also information on crops of *flax, potatoes, cotton, tobacco, hops, vines* and *sugar beet* in certain Northern Hemisphere countries, and on the progress of the sericultural campaign in Bulgaria, Italy, and Japan.

Following the above are some data on the 1914-15 crops in Argentina.

The Agricultural part of the Bulletin finishes with live stock statistical data collected in June, 1914, in the United Kingdom.

In the Commercial part, the Bulletin contains the usual tables of imports and exports of cereals, linseed, and cotton, and also of visible stocks of cereals and of the prices of cereals and cotton on the principal markets, the tables being as complete as present conditions allow.

Notes on Agriculture Abroad.

Federal Agricultural Budget of Canada.—In addition to a permanent annual expenditure of £188,000 authorised under the Agricultural Instruction Act for the various provinces comprising the Dominion, a sum of £689,000 is provided in the Canadian federal agricultural budget for 1915-6. The various items comprised in this total are as follows (*Agricultural Gazette of Canada*, May, 1915):—

	£
Experimental Farms—Maintenance of Central Farm, and establishment and maintaining of additional branch stations	163,500
Branch of Entomology	4,000
Administration and Enforcement of the *Destructive Insect and Pest Act*	21,000

	£
Development of the dairying industries, and the improvement in transportation, sale, and trade in food and other agricultural products	31,500
Fruit Branch	23,500
Encouragement of cold storage warehouses for the better preservation and handling of perishable food products	42,000
Health of Animals	112,500
Dominion Cattle Quarantine buildings—Repairs, renewals, &c.	3,000
Administration and enforcement of the *Meat and Canned Foods Act*	57,500
Publications Branch	3,000
International Institute of Agriculture, to assist in maintenance thereof and to provide for representation thereat	4,000
Development of Live Stock Industry	114,500
Enforcement of Seed Act, to test seeds for farmers and seed merchants, to encourage the production and use of superior seeds, and to encourage the production of farm and garden crops	29,000
National Biological Laboratory	5,000
Administration and carrying out provisions of the *Agricultural Instruction Act*	5,000
Grant to Dominion Exhibition	10,500
Exhibitions	58,500
Renewing and improving Canadian exhibit at Imperial Institute, London, and assisting in the maintenance thereof	1,000
Total	£689,000

Importation of Live Stock into Argentina.—The Board of Agriculture and Fisheries have been officially informed that the Argentine Government have issued a Decree revoking the prohibition of the importation of live stock from England and Wales. Animals may consequently now be imported into Argentina from any part of the United Kingdom. The exportation of cattle, sheep and swine is prohibited by Proclamation from the United Kingdom, but applications for licences to export may be made to the War Trade Department, 4, Central Buildings, Westminster, S.W.

Notes on Crop Prospects Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for June, 1915, issued by the International Institute of Agriculture, gives the condition of cereals in the more important countries on the 1st June, as follows (100 being taken to represent the prospect of an average crop):—*Wheat*—Canada, winter 116, spring 103; United States, winter 104, spring 101; Lower Egypt 96; Upper Egypt 101. *Rye*—Canada, 102. *Barley*—Scotland, 100; Ireland, 101; Canada, 99; United States, 104; Lower Egypt, 98; Upper Egypt, 103. *Oats*—Scotland, 100; Ireland, 101; Canada, 98; United States, 104.

Forecasts of Production.—The following estimates of the production of cereal crops are given:—*Wheat*—Italy, 25,254,000 qr. in 1914–15 against 21,174,000 qr. in 1913–14; Russia in Europe (54 governments), winter, 37,678,000 qr., against 26,851,000 qr.; United States, winter, 84,478,000 qr., against 85,601,000 qr.; spring, 34,241,000 qr., against 25,747,000 qr.; India, 47,908,000 qr., against 38,950,000 qr. *Rye*—Italy, 551,000 qr., against 613,000 qr; Russia in Europe (54 govern-

ments), winter, 109,837,000 qr., against 91,836,000 qr. *Barley*—Italy, 1,102,000 qr., against 830,000 qr.; United States, 23,633,000 qr., against 23,387,000 qr.; Japan, 11,698,000 qr., against 10,960,000 qr. *Oats*—Italy, 3,179,000 qr., against 2,751,000 qr.; United States, 132,066,000 qr., against 116,999,000 qr.

Argentina.—The third estimate of the cereal crops places the production of wheat in 1914–15 at 21,053,000 qr., against 14,234,000 qr. in 1913–14; of oats at 5,870,000 qr., against 5,227,000 qr.; and of maize at 39,450,000 qr., against 30,691,000 qr.

Australia.—Sowing of cereals for the agricultural year 1915–16 is proceeding under excellent conditions.

France.—The area under maize on 1st June was officially estimated at 766,000 acres, compared with 1,141,000 acres in 1914, and the area under potatoes at 3,217,000 acres, against 3,781,000 acres last year. The condition of maize was 70 against 69, and of potatoes 75 against 73 in 1914. (80 = good, 60 = fairly good.) (*The London Grain, Seed and Oil Reporter*, 28th and 30th June.)

Canada.—A Bulletin issued by the Dominion Government Census and Statistics Office, states that the estimated area under wheat is 12,896,000 acres, or 1,662,500 acres more than in 1914; under oats, 11,427,000 acres, an increase of 13 per cent.; and under barley, 1,518,000 acres. (*The London Grain, Seed and Oil Reporter*, 19th June.)

United States.—The Crop Reporting Board of the Department of Agriculture, in reporting as to crop conditions on the 1st July, states that the total production of winter wheat is estimated at 668,000,000 bush. as compared with a yield of 684,990,000 bush. last year; spring wheat at 295,000,000 bush. against 206,027,000 bush.; maize at 2,814,000,000 bush. against 2,672,804,000 bush.; oats at 1,399,000,000 bush, against 1,141,060,000 bush.; barley at 208,000,000 bush. against 194,953,000 bush. The condition of rye was 92·0 compared with 92·9 last year The proportion of last year's wheat crop still in farmers' hands was 3·3 per cent. (*The London Grain, Seed and Oil Reporter*, 8th July).

Argentina.—The *Review of the River Plate* of the 4th June states that the weather during the past week has been most suitable for maize operations. Ploughing is going on in all parts for the new wheat and linseed, and reports are satisfactory.

Fruit and Vegetables.—Holland.—His Majesty's Consul-General at Rotterdam reported that, on the 1st June, prospects for the fruit crop in Holland were generally favourable. *Apples* were very good in Groningen and most other parts of the country. *Pears* were also very good throughout the country, except Gelderland and Leeuwarden, where they were moderate. *Early Cherries* were very good in Limburg and in the Alblasserwaard, good in Gelderland and Overyssel, moderate in the Betuwe, and not good in the Hoeksche Waard. *Late Cherries* were excellent in Limburg and Maas district, and good in Betuwe, Utrecht, Gelderland north of the Rhine and Overyssel. "*English*" *Plums* were good in the south-east of Utrecht and the Alblasserwaard, moderate in Gelderland, Overyssel, and South Beveland, and bad near the Maas and Waal rivers. *Other Plums* were very good in Limburg, good in Utrecht, Overyssel, and Alblasserwaard, fairly good in the

Westland district, and moderate in other districts. *Tomatoes* were fairly good in Overyssel and Utrecht, and in other districts good or very good. Prices were 69*s.* per cwt. *Early Potatoes* were good to very good in Gelderland, Overyssel, Limburg, the greater part of Utrecht, West Friesland, and the Isle of Walcheren, fairly good in the Betuwe and moderate in the Westland. Prices for new potatoes were 10*s.* 6*d.* per cwt.

A further report, dated the 10th June, on the condition of vegetable and other crops, from His Britannic Majesty's Consul-General in Rotterdam, stated that most varieties of beans were good, and prospects for peas were good in the north, but only moderate in the south of the country. Canary seed varied from moderate to good. The crop of caraway would probably be below average; conditions were moderate in North Holland, but good elsewhere. Mustard seed was generally satisfactory. Prospects for potatoes were, on the whole, good, although there were some complaints of irregular development, and night frosts had done some damage. Onions varied from moderate to good, and chicory, which is being more largely cultivated this year in South Holland, offered good prospects.

His Majesty's Consul at Flushing, in a report, dated 18th June, stated that fruit seemed to have suffered somewhat from frost. Cherries, plums, and black currants would not yield as well as was at first expected. Pears had suffered from want of rain. Red and white currants, raspberries, and strawberries promised well.

His Majesty's Vice-Consul at s'Hertogenbosch, in a report, dated 14th June, stated that in his district "Bellefleur" apples promised a big crop, but other kinds would be less abundant. Raspberries and cherries afforded good prospects, plums and gooseberries pretty good, while those for pears were bad. In the same district it was expected that apples and pears would be dear.

France.—His Majesty's Vice-Consul at Caen, in a report, dated 10th June, gave the following information based on a report on the prospects of the fruit crops by Le Directeur des Services Agricoles du Calvados. Cider apples and pears promised plentiful crops as in the last three years, and, as the markets were more limited than before the war, low prices must be expected as in 1914, when they were about 4*s.* per cwt. In the Honfleur district, where table fruits are especially grown, the prospects for wall pears were bad, not exceeding a quarter of an average crop; but standard pears promised a plentiful crop. There would be a moderate yield of currants, and a poor crop of plums.

His Majesty's Consular Agent at Lorient, in a report, dated 15th June, stated that, in the Morbihan Department, an abundant crop of cider apples was expected, and, in view of the stocks of old cider, it was not probable that prices would exceed 50*s.* per ton. William pears would be more or less abundant, according to locality, and a certain amount might be available for export. Table apples promised well; it was too early to give quotations, but they were expected to be about £5 to £6 5*s.* per ton, according to quality. Chestnuts promised an abundant yield. The cultivation of strawberries had considerably developed around Vannes, and some hundredweights would be shipped daily to England from June till September. Cherries were a fairly big crop. It should be possible to export some quantity of the early kinds of plums and greengages.

His Majesty's Vice-Consul at St. Malo, in a report, dated the 18th June, stated that apples, whether for cider, cooking, or table purposes promised an abundant yield in his district. Plums afforded a better prospect than usual; gooseberries and currants were about an average, while cherries were a good medium, if not a large crop.

Hops.—*United States.*—His Majesty's Consul at Portland, Oregon, stated (June 21st) that the hop crop for the State of Washington was expected to be about 45,000 bales, which is slightly less than last year, while that of Oregon was expected to be from 130,000 to 160,000 bales, or slightly larger than last year. The hops were growing very well, the weather having been favourable, but aphides had appeared in a few places. Opening prices for the coming crop had been in some cases as high as 6½*d.*, but at the time of the Report were steady at from 5¼*d.* to 5½*d.* per pound. Very little of last year's crop was said to be left in growers' or dealers' hands.

Agricultural Labour in England and Wales during June.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st July, the supply of labour was everywhere deficient in greater or less degree; the shortage appeared to have been less felt in the northern counties. The fine weather of the month tended to mitigate the effects of the scarcity, and temporary labour in varions districts had been found among the military and women. The conditions in various districts were as follows:—

Northumberland, Durham, Cumberland and Westmorland.—In some districts a deficiency was not much felt, but in others there was a considerable shortage of temporary labour for turnip hoeing and hay making. More Irish labourers than usual were reported to be available in some parts, owing, it was stated, to higher wages.

Lancashire and Cheshire.—Some districts reported a shortage, others were fairly well supplied. The fine weather and light crops made the strain less felt.

Yorkshire.—The supply of labour was generally reported as deficient, but with fine weather and light hay crops this has not been felt as severely as might otherwise have been the case.

Shropshire and Stafford.—Labour was scarce throughout the district.

Derby, Nottingham, Leicester and Rutland.—There was a general deficiency, although owing to the light crops not so much labour was required for hay harvest, and in east Notts assistance was rendered by women and boys.

Lincoln and Norfolk.—Though labour was somewhat deficient, the shortage has not on the whole proved serious up to the present.

Suffolk, Cambridge and Huntingdon.—The supply was generally deficient, but the favourable weather and the light hay crops have assisted matters.

Bedford, Northampton and Warwick.—Labour was short everywhere, but owing to the light crops of hay and the fine weather the shortage so far has not caused much inconvenience.

Buckingham, Oxford and Berkshire.—Casual labour was very difficult to get, but the dry weather has reduced farm work, and the shortage was not so much felt as it would otherwise have been.

Worcester, Hereford and Gloucester.—Labour was short, particularly casual labour for hoeing, etc., and fruit pickers were fewer than usual. The work of the farm was, however, generally got through in most districts; various circumstances, such as fine weather, for the short hay

harvest, and help from women in many localities, having contributed to minimise the effects of a shortage.

Cornwall, Devon and Somerset.—The supply of labour was generally deficient.

Dorset, Wiltshire and Hampshire.—Labour was scarce, but in many districts the fine weather reduced the demand for extra hands for hay-making, and in Dorset farm work was mostly well in hand. Both here and in Hants a good deal of assistance was obtained from the military. In Wiltshire labour was very scarce.

Surrey, Kent and Sussex.—In one or two districts there was not any serious shortage, but generally labour was very scarce. Soldiers were employed in some instances.

Essex, Hertford and Middlesex.—Labour was everywhere short, but in varying degrees, particularly casual labour, but in most places the work was being done. In south Essex pea-pickers were not so numerous as usual; elsewhere women were helping. In Middlesex good wages (especially at piece-work) were being paid for poorer work, and mangold hoeing proceeded slowly.

North Wales.—There was a scarcity of labour, especially among temporary hands for turnip-hoeing.

Mid Wales.—A shortage of labour was generally reported, but the difficulties had not proved acute

South Wales.—Labour was everywhere more or less deficient, particularly casual workers.

Agricultural Conditions in England and Wales on 1st July.

THE Crop Reporters of the Board, in reporting on agricultural conditions in England and Wales on the 1st July, state that the past month was everywhere a very dry one, nearly every district experiencing a drought until about the 25th or 27th, when rains were fairly general throughout the country. The drought had a more or less injurious effect on all crops except wheat, but the rains in the last few days of June were of great benefit, especially to roots and pastures.

The wheat crop is generally healthy, and was little injured by the dry weather; nevertheless it will hardly prove an average, except in the south-west. Barley and oats have both wanted rain badly, and neither looks like yielding more than nine-tenths of an average crop. Barley is much the better of the two in the north; elsewhere there is not very much to choose between them. Straw is in nearly all districts very short. Beans are more satisfactory, and with wheat approaches more nearly to the average than any other crop; there is, however, much blight in some districts. Peas are less satisfactory, having been less able to withstand the drought.

Potatoes are generally backward. The cold nights prevailing in the first part of June resulted in frosts which did a certain amount of damage among the earlies; the main crop, however, took little harm. The recent rains will probably be of much benefit.

Turnips and swedes have suffered much from fly, and many fields have had to be re-sown, while a large number of farmers have waited for the rain before sowing. Comparatively little is consequently showing above ground. The recent rains should, however, enable much land to be sown and give the crop a start. Mangolds are usually backward for want of rain; they appear quite healthy; indeed there are some quite good fields, although there are many patchy ones.

Very good progress has been made with the clover hay crop, the bulk [illegible] in very good condition, although the

quantity is small. Harvesting the meadow hay is in full swing in the south, but has hardly commenced in the later districts; the yield is 20 per cent. below average. In a few districts in Wales and elsewhere the rain proved a hindrance, but this was not the case generally.

Pastures, with few exceptions, became very bare, but great improvement was expected from the rain. Live stock consequently only did fairly well as a rule; in some districts there was a little shortage of milk, and in others cattle were being helped with artificial feeding stuffs.

Hops were not suited by the dry weather and cold nights of June, and the bine is backward. Attacks of aphis have been most persistent, and constant washing has been necessary, but there is little mention of other pests. The outlook at present is for a poor crop.

There was abundant fruit blossom on the trees in most cases, but the dry weather caused a good deal of fruit to fall prematurely, and prospects are not so satisfactory as a month ago. Apples, plums and cherries are very variable, but probably below the average on the whole; pears—also very variable—are more abundant. Among small fruit, strawberries have been a small crop; raspberries should be about average, but currants and gooseberries will probably be poor crops.

Summarising the returns, and expressing an average crop by 100, the condition of the crops on the 1st July indicated probable yields which may be denoted by the following percentages:—Wheat, 98; barley, 90; oats, 90; beans, 98; peas, 95; potatoes, 95; mangold, 96; seeds' hay, 80; meadow hay, 79; hops, 86.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st July, 1915, certain diseases of animals existed in the countries specified:—

Denmark (month of May).

Anthrax, Foot-and-Mouth Disease (1,470 outbreaks), Glanders and Farcy, Swine Erysipelas.

France (for the period 6th—19th June).

Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox.

Holland (month of May).

Anthrax, Foot-and-Month Disease (123 outbreaks), Foot-rot, Glanders, Swine Erysipelas.

Italy (for the period 7th—13th June).

Anthrax, Blackleg, Foot-and-Mouth Disease (53 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosis.

Norway (month of May).

Anthrax, Blackleg, Swine Fever.

Rumania (for the period 14th—21st May).

Anthrax, Dourine, Glanders and Farcy, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Swine Fever.

Russia (month of January).

Anthrax, Foot-and-Mouth Disease (28,287 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (month of April).

Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (month of May).

Anthrax, Blackleg, Foot-and-Mouth Disease, (6 outbreaks), Swine Fever.

Switzerland (for the period 7th—13th June).

Anthrax, Blackleg, Foot-and-Mouth Disease (11 "étables" entailing 138 animals, of which 6 "étables" were declared infected during the period), Swine Fever.

No further returns have been received in respect of the following countries:—Austria, Belgium, Bulgaria, Germany, Hungary, Montenegro, Serbia.

The Weather in England during June.

District.	Temperature.		Rainfall.				Bright Sunshine.	
	Daily Mean.	Diff. from Average.	Amount.		Diff. from Average.	No. of Days with Rain.	Daily Mean.	Diff. from Average.
Week ending June 5th:	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours.
England, N.E. ...	52·7	+0·3	0·07	2	− 9	1	7·0	+0·7
England, E.	54·2	−0·3	0·01	0	−12	1	8·3	+1·3
Midland Counties ...	52·8	−1.6	0·08	2	−11	1	7·3	+1·1
England, S.E.... ...	52·5	−3·1	0·02	1	−11	1	7·6	+0·5
England, N.W. ...	51·7	−2·0	0·25	7	− 6	2	7·6	+0·8
England, S.W. ...	51·5	−3·2	0·13	3	− 9	2	8·3	+1·5
English Channel ...	53·7	−1·9	0·16	4	− 9	2	8·8	+0·8
Week ending June 12th:								
England, N.E.... ...	59·0	+5·5	0·04	1	10	1	8·1	+1·9
England, E.	61·3	+5·9	0·06	2	−11	1	8·0	+1·2
Midland Counties ...	61·0	+5·5	0·10	2	−10	1	8·0	+1·8
England, S.E.... ...	61·4	+4·9	0·09	2	−11	1	6·2	−0·7
England, N.W. ...	58·3	+3·5	0·11	3	− 8	1	6·6	−0·3
England, S.W. ...	59·2	+3·4	0·04	1	−12	1	6·2	−0·8
English Channel ...	59·5	+2·9	0·00	0	−11	0	4·3	−3·7
Week ending June 19th:								
England, N.E. ...	52·9	−1·5	0·00	0	−10	0	9·6	+3·4
England, E.	54·0	−2·1	0·00	0	−13	0	8·6	+2·1
Midland Counties ...	54·6	−1·6	0·00	0	12	0	10·0	+4·0
England, S.E	55·7	−1·5	0·00	0	−12	0	10·6	+3·9
England, N.W. ...	55·9	+0·2	0·00	0	−12	0	11·8	+5·2
England, S.W. ...	56·7	+0·2	0·01	0	−14	1	10·3	+3·4
English Channel ...	57·9	+0·5	0·08	2	− 8	1	6·9	−1·2
Week ending June 26th:								
England, N.E. ...	53·9	−2·1	0·34	9	− 2	2	5·5	−0·7
England, E.	56·2	−1·6	0·27	7	− 4	3	8·3	+1·5
Midland Counties ...	55·9	−1·7	0·45	12	0	2	6·1	0·0
England, S.E.... ...	57·1	−1·4	0·18	5	− 5	2	6·5	−0·4
England, N.W. ...	55·6	−1·4	0·65	17	+ 2	3	6·2	−0·1
England, S.W. ...	56·0	−1·6	0·97	25	+11	4	3·1	−3·7
English Channel ...	58·6	+0·1	0·81	21	+11	5	3·1	−5·0
Week ending July 3rd:								
England, N.E. ..	59·0	+1·4	0·72	19	+ 8	4	4·2	−2·3
England, E.	61·0	+1·4	1·21	31	+22	4	4·7	−2·7
Midland Counties ...	59·4	+0·2	0·86	22	+10	4	3·4	−3·2
England, S.E.... ...	60·0	−0·2	0·60	15	+ 6	3	5·2	−2·3
England, N.W. ...	58·7	+0·5	1·01	26	+11	5	4·0	−2·4
England, S.W. ...	58·0	−0·8	0·84	21	+ 8	4	4·2	−2·7
English Channel ...	59·2	+0·6	0·14	3	− 7	2	8·9	+0·5

* 1 inch = 25·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	JUNE.		SIX MONTHS ENDED JUNE.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	32	49	358	441
Animals attacked	38	53	401	471
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	11
Animals attacked	—	—	—	74
Glanders (including Farcy):—				
Outbreaks	12	11	25	53
Animals attacked	21	53	39	142
Parasitic Mange:—				
Outbreaks	85	123	*411	1,380
Animals attacked	166	209	*900	2,456
Sheep-Scab:—				
Outbreaks	2	3	156	147
Swine Fever:—				
Outbreaks	491	418	2,332	2,188
Swine Slaughtered as diseased or exposed to infection ...	2,438	4,645	10,777	22,571

* Figures for three months only, the Parasitic Mange Order of 1911 having been suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	JUNE.		SIX MONTHS ENDED JUNE.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	—	—	1	1
Animals attacked	—	—	1	1
Foot-and-Mouth Disease:—				
Outbreaks	—	1	—	75
Animals attacked	—	9	—	955
Glanders (including Farcy):—				
Outbreaks	—	—	1	—
Animals attacked	—	—	3	—
Parasitic Mange:—				
Outbreaks	13	4	36	49
Sheep-Scab:—				
Outbreaks	14	12	254	347
Swine Fever:—				
Outbreaks	19	12	140	116
Swine Slaughtered as diseased or exposed to infection ...	84	126	823	643

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in June and May, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	June. First Quality.	June. Second Quality.	May. First Quality.	May. Second Quality.
FAT STOCK:—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle:—	s. d.	s. d.	s. d.	s. d.
Polled Scots	13 6	12 5	12 10	11 9
Herefords	13 2	11 10	12 2	10 11
Shorthorns	13 1	11 11	12 3	11 4
Devons	13 2	12 0	12 3	11 5
Welsh Runts	12 11	12 3	—	—
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	10¾	9¾	11	10
Sheep:—				
Downs	11	10	11¾	10¾
Longwools	10¼	9¼	11	10
Cheviots	11¾	10¾	12¼	11¼
Blackfaced	11	10	12	11
Welsh	11	10	12	10¾
Cross-breds	11¼	10¼	11¾	10¾
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs:—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	9 4	8 9	9 4	8 9
Porkers	9 8	9 2	9 9	9 2
LEAN STOCK:—	per head.	per head.	per head.	per head.
Milking Cows:—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	25 12	20 18	25 6	20 17
" —Calvers ...	24 15	20 12	23 0	19 17
Other Breeds—In Milk ...	24 1	18 19	21 10	18 15
" —Calvers ...	18 10	17 10	17 15	16 17
Calves for Rearing	3 6	2 14	3 0	2 8
Store Cattle:—				
Shorthorns—Yearlings ...	13 15	11 15	13 10	11 13
" —Two-year-olds...	18 7	16 2	18 4	16 3
" —Three-year-olds	23 3	19 15	22 7	19 9
Herefords —Two-year-olds...	20 1	17 0	21 3	19 1
Devons— "	21 6	18 1	20 0	17 4
Welsh Runts— "	16 18	15 18	17 1	16 10
Store Sheep:—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	54 10	45 8	56 8	50 0
Store Pigs:—				
8 to 12 weeks old	26 3	20 7	24 10	19 3
12 to 16 weeks old	41 0	32 8	41 2	30 10

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in June, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham.		Leeds.		Liverpool.		London.		Manchester.	
		per cwt.		per cwt.		per cwt.		per cwt.		per cwt.	
		s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
BEEF:—											
English	1st	90	0	89	0	—		94	0	90	6
	2nd	85	6	85	0	—		89	0	86	6
Cow and Bull	1st	81	0	83	0	79	6	77	6	81	6
	2nd	76	6	74	6	74	0	73	0	76	0
Irish: Port Killed	1st	84	0	79	6	90	6	91	0	87	6
	2nd	—		74	6	85	6	87	0	83	0
Argentine Frozen—											
Hind Quarters	1st	75	0	77	0	76	0	77	6	76	0
Fore „	1st	69	6	72	6	67	0	67	6	67	0
Argentine Chilled—											
Hind Quarters	1st	84	6	84	0	83	6	83	6	83	6
Fore „	1st	70	6	69	6	70	0	70	0	70	6
Australian Frozen—											
Hind Quarters	1st	73	0	74	6	75	0	75	0	75	0
Fore „	1st	68	0	69	6	68	0	67	0	68	0
VEAL:—											
British	1st	87	6	84	0	89	0	87	6	87	6
	2nd	80	6	81	0	76	0	78	6	80	6
Foreign...	1st	—		—		—		93	0	—	
MUTTON:—											
Scotch	1st	—		—		98	6	99	6	98	0
	2nd	—		—		94	0	94	6	93	6
English...	1st	95	0	99	0	—		92	6	90	6
	2nd	87	6	94	0	—		86	0	85	0
Irish: Port Killed	1st	98	0	—		91	6	81	6	86	6
	2nd	93	6	—		85	0	77	0	81	6
Argentine Frozen	1st	66	6	66	0	65	0	66	0	65	0
Australian „	1st	65	0	62	6	62	6	63	0	62	6
New Zealand „	1st	66	6	66	0	—		68	6	—	
LAMB:—											
British	1st	99	0	109	0	98	6	100	0	99	0
	2nd	93	6	100	0	91	0	92	6	91	0
New Zealand	1st	80	6	82	0	82	6	81	6	82	6
Australian	1st	76	6	74	6	74	6	77	6	74	6
Argentine	1st	76	6	75	0	76	0	76	6	75	0
PORK:—											
British	1st	83	0	76	6	76	0	85	0	74	6
	2nd	79	6	73	6	70	6	79	6	68	0
Foreign...	1st	—		—		—		—		—	

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in June, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Bristol. First Quality.	Bristol. Second Quality.	Liverpool. First Quality.	Liverpool. Second Quality.	London. First Quality.	London. Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	16 0	15 0	—	—	15 3	14 3
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	143 0	141 0	140 0	137 6	142 0	138 6
„ Factory	133 6	130 0	132 6	129 0	133 0	129 0
Danish...	—	—	151 6	149 0	151 0	148 0
French...	—	—	—	—	138 6	133 6
Russian	—	—	135 0	133 0	132 6	128 6
Australian	—	—	139 0	136 0	141 0	137 0
New Zealand	147 6	146 0	143 6	141 6	144 6	141 0
Argentine	—	—	134 0	132 0	139 0	136 0
CHEESE:—						
British—						
Cheddar	103 0	101 0	103 0	102 0	101 6	97 6
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	90 6	85 6	98 0	93 0
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	94 6	92 0	93 0	91 0	94 6	91 6
BACON:—						
Irish (Green)	99 0	95 6	96 0	92 0	96 6	93 6
Canadian (Green sides)	89 0	85 6	87 0	85 0	88 0	85 0
HAMS:—						
York (Dried or Smoked)	120 0	116 0	—	—	120 0	116 0
Irish (Dried or Smoked)	—	—	—	—	116 0	111 0
American (Green) (long cut)	77 0	75 0	78 0	74 6	81 0	77 6
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120	per 120.
British...	13 9	12 11	—	—	15 0	14 2
Irish	13 7	13 4	13 8	13 1	14 5	13 11
Danish...	—	—	—	—	16 1	14 5
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
Edward VII.	95 6	86 0	85 0	80 0	99 6	89 0
Evergood	80 0	75 0	—	—	86 0	75 0
Up-to-Date	95 6	80 6	68 6	63 6	97 6	88 6
HAY:—						
Clover...	—	—	120 0	95 0	112 0	104 0
Meadow	—	—	—	—	106 0	98 6

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	WHEAT.						BARLEY.						OATS.					
	1913.		1914.		1915.		1913.		1914.		1915.		1913.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Jan. 2...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
,, 9...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
,, 16...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
,, 23...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
,, 30...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
,, 13...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
,, 20...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
,, 27...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
,, 13...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
,, 20...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
,, 27...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3...	31	4	31	6	54	6	27	0	25	6	31	9	19	2	18	5	30	6
,, 10...	31	3	31	5	54	9	27	8	26	8	31	3	19	2	18	4	30	4
,, 17...	31	6	31	7	55	4	26	11	25	4	30	10	18	10	18	4	30	5
,, 24...	31	8	31	9	56	5	26	7	26	6	31	5	19	3	18	5	30	11
May 1...	32	2	31	9	58	3	25	11	26	0	32	7	19	6	18	5	31	5
,, 8...	32	6	32	2	60	5	25	9	25	6	33	3	19	6	18	9	32	4
,, 15...	32	10	32	7	61	7	25	4	26	3	34	0	19	9	18	11	32	5
,, 22...	32	10	33	0	62	0	25	3	25	10	34	1	19	11	19	0	32	8
,, 29...	32	7	33	9	61	11	26	1	26	1	34	8	20	1	19	4	32	7
June 5...	32	10	34	0	61	9	26	2	25	11	35	4	19	8	19	4	32	5
,, 12...	32	8	34	1	60	1	24	7	24	11	34	5	20	2	19	8	32	4
,, 19...	32	8	34	1	56	1	23	10	25	10	34	3	19	8	19	9	31	9
,, 26...	32	8	34	3	52	0	24	3	25	4	34	4	19	1	20	0	31	9
July 3...	33	1	34	4	49	5	25	2	24	6	35	3	21	0	19	9	31	1
,, 10...	33	4	34	2			25	10	24	9			19	4	20	0		
,, 17...	33	6	34	1			24	9	24	2			20	5	19	10		
,, 24...	33	10	34	0			24	1	24	7			20	8	19	9		
,, 31...	34	1	34	2			24	5	25	9			20	3	19	8		
Aug. 7...	34	1	34	9			24	9	25	2			19	0	19	1		
,, 14...	34	3	40	3			24	7	29	4			18	7	25	1		
,, 21...	33	7	38	9			26	5	29	10			18	8	24	3		
,, 28...	32	7	36	2			29	0	30	3			17	10	23	5		
Sept. 4...	31	11	36	5			30	11	30	6			17	8	23	9		
,, 11...	31	9	37	10			31	5	29	11			18	0	23	11		
,, 18...	31	7	38	3			30	9	29	5			17	11	23	8		
,, 25...	31	6	37	6			30	1	29	3			17	9	23	3		
Oct. 2...	31	3	37	1			29	9	29	1			17	10	22	9		
,, 9...	31	0	36	8			29	1	28	10			17	10	22	5		
,, 16...	30	11	36	7			28	8	28	8			17	9	22	4		
,, 23...	30	7	37	2			28	7	28	7			18	0	22	5		
,, 30...	30	1	37	10			28	2	28	3			17	9	23	7		
Nov. 6...	30	0	38	8			28	1	28	6			17	9	23	7		
,, 13...	30	1	39	8			27	8	29	0			17	11	24	8		
,, 20...	30	4	41	0			27	5	29	8			18	1	25	5		
,, 27...	30	9	41	11			27	0	30	3			18	4	25	8		
Dec. 4...	31	2	42	2			26	8	30	2			18	4	25	9		
,, 11...	31	2	42	1			26	5	29	11			18	6	25	9		
,, 18...	31	2	42	7			25	11	29	8			18	5	25	9		
,, 25...	31	0	43	3			25	10	29	9			18	4	25	11		

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of June, 1914 and 1915.

	Wheat.		Barley.		Oats.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
London	35 5	58 5	24 10	35 1	20 2	33 5
Norwich	34 1	58 5	24 9	33 4	18 11	31 9
Peterborough	33 5	54 8	22 2	33 3	19 1	31 8
Lincoln	34 5	56 2	23 3	33 8	20 4	31 4
Doncaster	34 0	54 4	28 2	—	19 8	31 3
Salisbury	33 2	57 4	22 4	34 8	19 8	31 8

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

U.S. Department of Agriculture. Office of the Secretary.—Report 104:—Domestic Needs of Farm Women. (100 pp.) Report 105:—Educational Needs of Farm Women. (88 pp.) Report 106:—Economic Needs of Farm Women. (100 pp.) Washington, 1915. [376.]

Cubberley, E. P.—Rural Life and Education: a Study of the Rural-School Problem as a Phase of the Rural-Life Problem. (367 pp.) Boston, U.S.A.: Houghton, Mifflin Co.; London: Cambridge University Press. 1914. $1.50. [37 (73).]

"*Farmer Giles.*"—War on Weeds; How to Double our Food Supply. (60 pp.) London: "The Smallholder" Offices, 1915. 6*d.* net. [63.259(02).]

"*Farmer Giles.*"—Manures and Manuring. (172 pp.) London: "The Smallholder" Offices, 1914. 1*s.* net. [63.16(02).]

"*G. C. P.*"—The Land after the War: a Business Proposition (73 pp.) London: St. Catherine Press, 1915. 1*s.* net. [63(022).]

U.S. House of Representatives.—Special Agents Series, No. 52:—Utilization of Atmospheric Nitrogen. (178 pp.) Washington, 1912. [63.1671.]

Livingston, B. E. and *Hawkins, L. A.*—The Water-Relation Between Plant and Soil. (48 pp.) Washington: Carnegie Institution, 1915. [63.11(04).]

Pulling, H. E. and *Livingston, B. E.*—The Water-Supplying Power of the Soil as Indicated by Osmometers. (49–83 pp.) Washington: Carnegie Institution, 1915. [63.11(04).]

California Agricultural Experiment Station.—Bull. 248:—The Economic Value of Pacific Coast Kelps. (183–215 pp.) [63.165.] Bull. 251:—The Utilization of the Nitrogen and Organic Matter in Septic and Imhoff Tank Sludges. (287–295 pp.) [63.164.] Berkeley, Cal., 1915.

Armstrong College.—College Bull. 12:—Lime and its Uses in Agriculture. (24 pp.) Newcastle-on-Tyne, 1915. [63.15.]

U.S. Department of Agriculture.—Farmers' Bull. 651:—A Method of Analyzing the Farm Business. (26 pp.) [338.58; 657.] Farmers' Bull. 660:—Weeds: How to Control Them. (29 pp.) [63.259(04).] Washington, 1915.

New York Agricultural Experiment Station.—Technical Bull. 35:—Bacteria of Frozen Soil. (20 pp.) [63.115.] Technical Bull. 38:—Culture Media for Use in the Plate Method of Counting Soil Bacteria

Field Crops—

U.S. Department of Agriculture.—Bull. 183 :—Morphology of the Barley Grain with Reference to its Enzym-Secreting Areas. (32 pp.) 1915. [63.313.] Bull. 211 :—Factors affecting Range Improvement in New Mexico. (39 pp.) 1915. [63.33(*a*).] Bull. 222 :—Barley in the Great Plains Area: Relation of Cultural Methods to Production. (32 pp.) 1915. [63.313.] Farmers' Bull. 669 :—Fiber Flax (19 pp.) Washington, 1915. [63.34111.]

Seeley, E.—The Tillering of Wheat. (69–80 pp.) [Journal of the Farmers' Club, May. 1915.] London: 2, Whitehall Court. 6*d.* [63.311.]

Iowa Agricultural Experiment Station.—Research Bull. 16 :—Chemical Changes during Silage Formation. (22 pp.) Ames, Iowa, 1914. [63.604(*a*).]

Horticulture—

University of Leeds and Yorkshire Council for Agricultural Education.—Bull. 95 :—The Systematic Cropping of Vegetable Gardens and Allotments. (20 pp.) Leeds, 1915. [63.51(04).]

U. S. Department of Agriculture.—Bull. 175 :—Mushrooms and other Common Fungi. (64 pp.) Washingtoo, 1915. [63.518.]

Plant Diseases—

Missouri Agricultural Experiment Station.—Bull. 124 :—Profits from Spraying Twenty-five Missouri Orchards in 1914. (187–285 pp.) Columbia, Missouri, 1915. [63.294.]

U.S. Department of Agriculture.—Farmers' Bull. 648 :—The Control of Root-Knot. [Caused by *Heterodera radicicola.*] (19 pp.) Washington, 1915. [63.27.]

U.S. Department of Agriculture.—Bull. 197 :—Home-made Lime-Sulphur Concentrate. (6 pp.) Washington, 1915. [63.295.]

New South Wales Department of Agriculture.—Science Bull. 13 :—Lime-Sulphur Sprays: Their Manufacture, Composition, and Use. (19 pp.) Sydney, 1915. [63.295.]

Connecticut Agricultural Experiment Station.—Bull. 186 :—The Gypsy Moth. (24 pp.) New Haven, Conn., 1915. [63.27.]

Smith, Erwin F.—Bacteria in Relation to Plant Diseases. Vol. III. Vascular Diseases (continued). (309 pp. + 47 plates.) Washington: Carnegie Institution, 1914. [63.23.]

Iowa Agricultural Experiment Station.—Bull. 145 :—The Effect of City Smoke on Vegetation. (383–409 pp.) Ames, Iowa, 1913. [614.7.]

New Jersey Agricultural Experiment Station:—Circ. 35 :—Some Diseases of Nursery Stock. (24 pp.) New Brunswick, New Jersey. [63.24-41.]

Live Stock—

University of Leeds and Yorkshire Council for Agricultural Education.—Bull. 94 :—The Food and Manure of Young Pigs. (24 pp.) Leeds, 1915. [347(*a*); 63.64.]

Ireland, Department of Agriculture and Technical Instruction.—Report of the Departmental Committee on the Irish Pig-Breeding Industry. [Cd. 7890.] (18 pp.) London: Wyman & Sons, 1915. 2½*d.* [63.6(415).]

Pegler, Holmes H. S.—The Advantages of Goat-Keeping: with Hints on Milking, Feeding and Breeding Goats. (12 pp.) London: British Goat Society, n.d. [63.63.]

Tod, W. M.—Hints on Feeding: a Practical Book on the Feeding of Live Stock. (204 pp.) Basingstoke: Bird Bros., 1915. [63.604.]

Kentucky Agricultural Experiment Station.—Bull. 190 :—I. Value of Distillers' Dried Grains in Swine Feeding Operations. II. The Value of Wheat as a Feed for Swine. (27 pp.) Lexington, Ken., 1915. [63.64.]

U.S. Department of Agriculture.—Farmers' Bull. 612 :—Breeds of Beef Cattle. (23 pp.) 1915. [63.62(04).] Farmers' Bull. 619 :—Breeds of Draft Horses. (16 pp.), 1914. [63.61(04).] Farmers' Bull. 655 : Cottonseed Meal for Feeding Beef Cattle. (8 pp.). 1915. [63.62]. Farmers' Bull. 667 :—Breaking and Training Colts. (16 pp.) [63.61(04).] Washington, 1915.

Veterinary Science—

U.S. Department of Agriculture.—Farmers' Bull. 666 :—Foot-and-Mouth Disease. (16 pp.) Washington, 1915. [619.2(*d*).]

Dairying and Food, General—

Wisconsin Agricultural Experiment Station.—Bull. 244 :—Organization and Construction of Creameries and Cheese Factories. (51 pp.) [63.728 ; 63.73.] Bull. 245 :—The Disposal of Creamery Sewage. (20 pp.) [63.70(04) ; 628.2.] Madison, 1915.

U.S. Department of Agriculture.—Bull. 202 :—The Alcohol Test in Relation to Milk. (35 pp.) Washington, 1915. [543.2.]

New York Agricultural Experiment Station.—Technical Bull. 34 :—I. Why Sodium Citrate Prevents Curdling of Milk by Rennin. II. The Use of Sodium Citrate for the Determination of Reverted Phosphoric Acid. (12 pp.) [63.71(04).] Technical Bull. 37 :—Studies Relating to the Chemistry of Milk and Casein. (11 pp.) [63.712.] Technical Bull. 39 :—Condition of Casein and Salts in Milk. (17 pp.) [63.727.] Geneva, N.Y., 1914.

Birds, Poultry, and Bees—

Broomhead, W. W.—The Management of Chickens. [2nd edition.] (110 pp.) London : "Poultry" Office, 1915. 1s. [63.651(04).]

Forestry—

Weiss, H. F.—The Preservation of Structural Timber. (312 pp.) New York : McGraw-Hill Book Co., 1915. [63.49-198.]

Shaw, N.—Chinese Forest Trees and Timber Supply. (351 pp.) London : T. Fisher Unwin, 1914. 10s. 6*d*. net. [63.49(5).]

Saxton, W. J.—The Classification of Conifers. (21 pp.) [New Phytologist. Reprint No. 8.] Cambridge : Botany School, 1913. 1s. [63.492.]

U.S. Department of Agriculture.—Bull. 210 :—Seed Production of Western White Pine. (15 pp.) Washington, 1915. [63.492.]

Peets, E.—Practical Tree Repair. (265 pp.) London : The "Field and Queen," 1915. 7s. 6*d*. net. [63.49-2.]

Engineering—

Fortier, S.—Use of Water in Irrigation. (265 pp.) London : Hill Publishing Co., 1915. 8s. 4d. net. [63.13.] [The author is Chief of Irrigation Investigations in the U.S. Dept. of Agriculture.]

Haines, A. H. and *Daniel, A. F. Hood.*—Surveying and Building Construction for Agricultural Students, Land Agents and Farmers. (339 pp.) London : Longmans, Green & Co., 1915. 10s. 6*d*. net. [52 ; 69(02).]

South Dakota Agricultural Experiment Station.—Bull. 154 :—The Pit Silo (81–96 pp.) Brookings, S. D., 1914. [69.]

Economics—

Herrick, M. T. and *Ingalls, R.*—Rural Credits : Land and Co-operative. (519 pp.) New York and London : D. Appleton & Co., 1914. 6s. 3*d*. net. [332.71(02).]

Johnston, J. H. Clifford.—A National Agricultural Policy : The Finance of Occupying Ownership and Co-operative Credit. (39 pp.) London : P. S. King & Son, 1915. 6*d*. net. [338.1.]

Rome, International Institute of Agriculture.—Steadying the World's Price of the Staples. An International Commerce Mission on Ocean Freight Rates. Resolutions passed by the Congress of the U.S. (48 pp.) Rome, 1915. [382.]

Coulter, J. L.—Co-operation among Farmers. The Keystone of Rural Prosperity. (281 pp.) New York : Sturgis & Walton Co., 1914 75 cents net. [334(02).]

Rome, International Institute of Agriculture.—Monographs on Agricultural Co-operation in various Countries. Vol. II. Argentina, Austria, &c (213 pp.) Rome, 1915. 3 fr. 50. [334(02).]

New York State Department of Agriculture.—Bull. 66 :—Agricultural Organizations in European Countries. (451–636 pp.) Albany, N.Y. 1914. [334(4).]

(3962.) Wt. P. 16—9. [illegible] 7/15. J. T. & S., Ltd.

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 5

AUGUST, 1915.

HOW CAN CROPS BE GROWN WITHOUT POTASH MANURES NEXT YEAR?

E. J. RUSSELL, D.Sc.

Rothamsted Experimental Station.

THE possibility that crops may have to be grown withou potash manures next season necessitates a careful examinatio of the whole problem, with a view to finding out the best course to be adopted in the circumstances.

Potash manures are only of recent use in this country, and the were not imported in any quantity until about 1890. All the goo farming of the 'sixties was done without them. Two importan potash-needing crops, however, are grown more commonly nov than then, viz., potatoes and mangolds, and these have only bee possible on our present scale since the introduction of potas manures; the leguminous crops, clovers, lucerne, vetches, pea beans, etc., also stand in need of much potash. These are th crops that need it most, but they are vitally necessary now and are almost entirely produced at home, the imports bein simply a small proportion of potatoes. How, then, is it possibl to arrange a supply of potash for them?

Two methods may be adopted:—(1) Other sources of potas can be used instead of the ordinary Stassfurt salts; and (2) th supplies of potash in the soil can be made available.

Sources of Potash other than Stassfurt Salts.

(*a*) VARIOUS ASHES, ETC.—Numerous efforts have been mad in the past to utilise various potash minerals which occur in quan tity in different parts of the world outside Germany, but thes have not materialised on a large scale, and, in consequence, n of them is available to helo at the present time. Since tl

began, however, attention has been directed to various sources of supply which are or could be brought immediately within the reach of farmers. These sources are included in Table 1.

TABLE 1.—SOURCES OF POTASH OTHER THAN STASSFURT SALTS AVAILABLE ON THE FARM.

Material.	Percentage of Potash (as K_2O).*	Further information is given in :—
Ashes of Seaweed ..	16	This *Journal*, Vol. 17, p. 464.
,, ,, *Bracken* ..	2·5	,, ,, Vol. 15, p. 481.
,, ,, Hedge trimmings.	10	,, ,, Vol. 21, p. 694.
,, ,, Waste cavings and waste from threshing ..	8 to 10	,, ,, ,, ,,
,, ,, Wood waste, sawdust, etc...	5 to 7	Gimingham, Long Ashton, *Rpt.*, *1914*.
Flue dust from saw mills	up to 10	,, ,, ,,

* Kainit contains 12 per cent. of Potash as K_2O.

In all these cases except the last the potash is present as carbonate, a very soluble and highly available fertiliser. Its drawback is that it is rather too soluble, so that the ashes have to be kept dry and, above all, carefully shielded from rain, or they may lose half their value in a single night. They can safely be mixed with superphosphate before distribution, and applied at the rate of about 3 cwt. per acre.

Attention having recently been directed in this *Journal* to most of these substances, it is unnecessary to do more than emphasise once again the urgent necessity of preserving them carefully, and, when practicable, of increasing the supplies by collecting hedge trimmings, prunings, dead bracken, and other waste vegetation for burning and conversion into ash.

Seaweed contains so much potash and such good fertilising material generally, that we may yet hope to utilise it better than at present.

(*b*) FARM PRODUCTS.—Farm crops contain considerable proportions of potash, as shown in Table 2. Mangolds easily head the list, a 40-ton crop containing in the roots alone no less than 400 lb. of pure potash, equivalent to 30 cwt. of kainit, while the leaves contain an additional 150 lb. of potash, equivalent to 11 cwt. of kainit. It is evident that the leaves represent a useful source of potash, and should not be wasted; they should be spread evenly on the soil and ploughed in; decomposition rapidly begins, and the potash is set free. They are relatively free from insect and fungoid pests, and there is little if any risk of introducing harmful organisms into the soil to injure the next crop.

Hay shows great variations in potash content according to the richness of the soil in which it is grown. The hay from the Rothamsted unmanured plot contains only 1·25 per cent.; accordingly the whole crop only removes 28 lb. per acre from the soil. On the other hand, the hay from the plots receiving nitrate of soda, superphosphate, potash and other mineral manures, contains 2 per cent. and removes the very large amount of 109 lb. per acre. Ordinary meadow hay comes somewhere between these figures; it contains about 1·6 per cent., and a 30-cwt. crop removes only 54 lb. of potash from the soil per acre.

TABLE 2.—APPROXIMATE POTASH CONTENT OF VARIOUS FARM PRODUCTS.

Crop or Produce.	Size of Crop per Acre.	Weight of Potash (K_2O) removed per Acre.	Proportion of Potash in the Crop.	Weight of Potash in 1 ton of Crop.	Approximate weight necessary to furnish as much Potash as 4 cwt. of Kainit.
		lb.	Per cent.	lb.	tons.
Mangolds, roots ..	40 tons.	400	0·45	10	5½
,, leaves	15 ,,	150	0·45	10	5½
Turnips, roots ..	20 ,,	110	0·25	5½	10
Potatoes, tubers..	8 ,,	108	0·6	13½	4
Clover hay ..	2 ,,	68	1·5	34	1½
Hay from well-manured land*	2½ ,,	101	2·0	45	1¼
Hay from unmanured land†	1 ,,	28	1·25	28	2
Ordinary meadow hay	1½ ,,	54	1·6	36	1½
Oats, grain ..	60 bushels (2,400 lb.)	12	0·5	11	5
Oats, straw ..	32 cwt.	36	1·0	22	2½
Wheat, grain ..	40 bushels (2,480 lb.)	12	0·5	11	5
Wheat, straw ..	36 cwt.	32	0·8	18	3

* Rothamsted Park hay, Plot 16 (mixed mineral manure and nitrate of soda).
† Rothamsted Park hay, unmanured. Analytical data given in Phil. Trans., 1900, Vol. 192, p. 199.

The potash in these crops is drawn partly from the original stock in the soil, and partly from purchased manures and feeding stuffs. If the crops are sold off the land, the potash is entirely lost to the farm, but more usually the mangolds, turnips, and part of the hay and straw are consumed on the farm. It is interesting to notice that these—the hay and root crops—contain by far the greatest proportion of potash. With the striking exception of potatoes, the crops sold off do not remove much potash, grain in particular taking away relatively very little. This shows how

ittle justification there is nowadays, so far as the supply of potash s concerned, for restrictions on freedom of sale of straw, or on :aking two white straw crops in succession.

Where the crops are consumed on the farm, a certain proportion of the potash finds its way into the manure, and so back to the land. It thus keeps circulating between the soil, the crop, the ınimal and the manure heap, and we must now enquire what osses arise during the process, and how they may be stopped.

Potash Retained by Live Stock.—Potash is less retained by live stock than any other ingredient of manurial value in their food. This was demonstrated in 1883 by Lawes and Gilbert,* when hey worked up the detailed analyses of the ashes of the animals laughtered during their famous experiments of 1849-50.† The ncrease of weight during fattening was found to contain 1·27 per cent. of nitrogen, 0·86 per cent. of phosphoric acid, but only 0·11 per cent. of potash; in other words, for every hundredweight of lesh laid on, a fattening animal retains only 2 oz. of potash.

Milch cows naturally retain more. Milk contains about 0·17 per cent. of potash, so that 100 gal. contain approximately $\frac{2}{3}$ lb. Generally speaking, milch cows retain about 10 to 15 per ent. of the potash present in a normal mixed diet, but Lawes ınd Gilbert calculated that a higher proportion is retained in the ase of certain concentrated foods.‡

The Amount of Potash Passing into the Manure.—About 10 per cent. of the potash present in the animal's food is ıssimilated and passes into the animal's circulation. It has been hown above that the animal does not keep it. What then ıappens to it? The answer is that it is excreted in the urine, in which form it is a highly available fertiliser. Some interesting xperiments were made on this subject by Sweetser at the Pennsylvania State College Experiment Station§ in 1899, two ows being tested over five periods of 40 days each. During the ıst ten days of each period the cows were put upon digestion rials, and a careful record was kept of the amount and composition of the food eaten, and of the milk and the excretions. For the 50 days of these observations the results (added together) or the two cows were as follows:—

* Phil. Trans., 1883, pp. 865–890. The application of these results to e problem of evaluating unexhausted manures is made in Jour. Roy. Agric. Soc., 1885, Ser. ii, Vol. 21, pp. 590–611.

† Phil. Trans., 1859, pp. 493–678; the results are discussed also in Jour. Roy. Agric. Soc., 1860, Ser. i, Vol. 21, pp. 433–488.

‡ Jour. Roy. Agric. Soc., 1898, Ser. iii, Vol. 9, pp. 103–117.

§ Pennsylvania State College. Annual Rept., 1899–1900: also Bull.

—	Quantity.	Potash.		Phosphoric Acid.		Nitrogen.	
		Amount present.	Proportion of total excreted.	Amount present.	Proportion of total excreted.	Amount present.	Proportion of total excreted.
	lb.	lb.	Per cent.	lb.	Per cent.	lb.	Per cent.
Milk ..	2279·4	4·5	10	4·7	23	11·4	17
Fæces (fresh)	4567·4	7·1	15	15·5	75·5	21·5	31
Urine ..	2680·6	34·2	75	0·3	1·5	36·1	52

It does not appear that more recent experiments have been made, but there is no reason to doubt the general result. The high content of potash is characteristic of urine, and is one of the reasons why special care should be taken to save it at the present time. There are three ways in which this can be done: (1) by using enough litter to soak it up, (2) by protecting the manure heap against loss, and (3) by adopting suitable means of collecting it.

Losses from the Manure Heap.—Farmyard manure contains its potash in two forms: the soluble compounds coming from the urine, and the insoluble compounds present in the litter. The sum of the two amounts to about 15 lb. of potash per ton of manure, or rather more than the quantity found in 1 cwt. of kainit or ¼ cwt. of sulphate of potash. The soluble part is liable to considerable loss by washing and drainage unless the heap is adequately protected from heavy rainfall.

At Rothamsted the following losses were found to occur:—

	Heap sheltered from rain, drainage at a minimum.		*Heap exposed to rain, considerable drainage.*
Potash originally present in heap, lb.	147	..	175
Potash left after three months' storage .. .. lb.	130	..	123
Potash lost .. .. .. lb.	17	..	52
" " per cent. of total ..	12	..	30

The liquid draining away from the heap contains the potash; if it is carefully kept the loss is less serious. Hendrick* has recently shown that on an average it contains 0·46 per cent. of potash, or 300 gal. contain about as much as is present in 1 cwt. of kainit, and in an admirable state of availability. Good results were obtained by applying it to grass land.

It appears, then, that the waste of potash on the farm need not be great. The chief points of leakage are the cattle yard and

* N. of Scotland Coll. of Agric., Bull. No. 19, 1915 (see this *Journal*, July, 1915, p. 346).

the manure heap, and the chief way in which loss arises is through wastage of the urine and of the brown liquid draining away from the manure. If these sources of loss are stopped, the circulation of potash between the soil, the crop, and the manure heap can be kept up without much loss.

It is now clear why potash did not enter more largely into the scheme of manuring on British farms prior to the more extended cultivation of the potato. A farm worked on the old four-course rotation, and selling only grain and meat, can be made largely self-supporting in the matter of potash supplies if the manure heap is properly managed and the liquid manure is preserved. The bulk of the potash taken up by the cereal crop remains in the straw and does not pass into the grain: thus, so long as the straw is kept on the farm the supply is only slowly exhausted. Fattening and milking cattle only retain a small part of the potash supplied in the food, even a milch cow only passing some 10 per cent. into its milk; all the remainder goes out in the excretions. Even at the present day many farms are still largely self-supporting in this respect, though this does not in any way mean that the farmer need not concern himself with the matter; on the contrary, it gives him an added responsibility, because the parts of the crop containing potash are just those as to which least care is usually exercised and of which most waste is commonly seen.

(*c*) Residue of previous Crops, especially Clover Leys, Grass Land, etc.—A certain proportion of the potash taken up by plants is retained by the root system, and becomes available to the next generation of plants when the roots begin to decay. It is difficult to ascertain precisely what quantity thus becomes available when grass land and clover leys are ploughed up, but it must be considerable. The old estimates, made in 1869 by Weiske and Werner at Halle, showed that from 40 to 80 lb. of potash (K_2O) and 120 to 190 lb. of nitrogen were left in each acre of roots and residues of clover crops. The figures obtained by Woods in Connecticut, and more recently by Hotter, Herrmann and Stumpf in Austria, are given in Table 3.

These estimates are in the nature of things incomplete, because they take no account of the roots which have decayed. Further, Dr. Cyril Hopkins, of Illinois, has adduced evidence that the decay of clover roots increases the solubility of the potassium minerals in the soil, and any such action would make the estimates still more incomplete. It is, therefore, safe to regard them as minimum estimates only. Numerous field experiments show the

TABLE 3.—ESTIMATED AMOUNTS OF POTASH, PHOSPHORIC ACID AND NITROGEN, LEFT IN THE SOIL BY THE ROOT RESIDUES OF VARIOUS CROPS: LB. PER ACRE.

Crop.	Potash (K_2O).			Phosphoric Acid (P_2O_5).			Nitrogen (N).		
	*Weiske and Werner.	†Woods.	‡Hotter, Herrmann and Stumpf.	*Weiske and Werner	†Woods.	‡Hotter, Herrmann and Stumpf.	*Weiske and Werner.	†Woods.	‡Hotter, Herrmann and Stumpf.
Red Clover ..	82·5	—	35·5	75·4	—	52·7	193	—	158
Lucerne ..	37	—	128	40	—	104·5	137	—	271
Sainfoin ..	43	—	—	30	—	—	124	—	—
Wheat ..	18·6	—	18	10	—	21	24	—	69
Oats	25	—	35·5	30	—	27·3	27	—	64
Buckwheat ..	9·3	3·8	—	11	1·3	—	48	4·4	—
Timothy and Red Top in top 3 feet. ..	—	55·8	—	—	25·2	—	—	90·0	—
Timothy and Red Top in top 6 inches ..	—	53·5	—	—	23·8	—	—	83·7	—
Old grass land..	—	—	44·5	—	—	34·5	—	—	143

* H. Weiske, Werner, E Schmidt and E. Wildt, *Landw. Versuchs-Stat.*, 1871, Vol. 14, 105.
† C. D. Woods, *Storrs School Expt. Station, Conn. Ist. Rept.*, 1888, 28–43.
‡ Ed. Hotter, E. Herrmann and J. Stumpf, *Zeits. Landw. Versuchs. Oesterreich*, 1911, 14, 152–174.

great manurial value of these residues on the succeeding crop. Three only need be quoted, all from Hoosfield, Rothamsted; they are given in Table 4:—

TABLE 4.—EFFECT OF ROOT RESIDUES FROM LEYS ON THE SUCCEEDING CEREAL CROPS.

	BARLEY. Hoosfield 1906.			WHEAT 1899.		
	After Clover ley.	After Barley.		After Sainfoin ley (Hoosfield).	After Wheat (Broadbalk).	
	No manure.	No manure.	Complete artificials.*	No manure.	14 tons dung.	Complete artificials.*
Grain, bush. per acre	36·2	11	52	45·25	42·5	31·25
Straw, cwt. per acre	25·6	6·5	26·5	50	52·5	40·4

* Including 400 lb. ammonium salts in both cases.

	After Lucerne ley, three crops in succession without manure. Hoos leguminous plots.		After Fallow, 1912. Complete Artificials each year. Hoosfield permanent barley plots 4 A.	
	Grain. bush.	Straw. cwt.	Grain. bush.	Straw. cwt.
1912 Oats ..	51	29·5	No crop.	
1913 Barley ..	55	26·5	61	30
1914 Barley ..	33	18	33	19

These results are, of course, only in part attributable to the potash, or even to the nitrogen, but they are significant in view

of the suggestion to plough up poor grass land and bring it again into arable cultivation. The indications are that such land would stand less in need of potash manure than ordinary arable land.

Methods of Rendering the Potash Reserves in the Soil Available.

Although potassium fertilisers are easily soluble in water, they do not readily wash out from the soil, because they become absorbed or fixed by some of the soil constituents. Wherever high farming has been practised, and large quantities of potash salts, stable manure, or feeding stuffs have been imported on to the farm, the amount of potash supplies may well have been greater than the amount removed by the crop. A certain accumulation has therefore taken place in the soil, forming a reserve which can be drawn upon in the present emergency. The process is essentially one of liquidating capital, and if persisted in for many seasons might have bad effects, but as a war measure no harm need be anticipated.

Two general methods may be adopted: (1) dressings of sodium salts may be applied, such as agricultural salt or sulphate of soda, or (2) the land may be limed. Both processes liberate some of the locked-up potash, but they show certain differences that require discussion.

The use of salt or sulphate of soda as a liberator of potash has long been recognised by agricultural chemists. At Rothamsted sodium salts are successfully used on wheat and on mangolds, and analysis shows that they increase the availability of soil potash to the plant.

TABLE 5.—EFFECT OF SODA IN CAUSING THE LIBERATION OF POTASH FROM THE SOIL (ROTHAMSTED).

—	Wheat, Broadbalk field, 1852–1871.			Mangolds, Barnfield 11 years, 1903–1914.*
Manurial Treatment.	Yield of Grain per acre.	Yield of Straw per acre.	Total Potash taken by Crop in the 20 years per acre.	Yield per acre.
	bush.	cwt.	lb.	tons.
Ammonium salts only	26	23	540	6·9
Ammonium salts + Super.	28	26	569	7·1
Ammonium salts + Super. + Sulphate of Soda	34	32	832	23·8
Ammonium salts + Super. + Sulphate of Potash	34	34	1,084	23·0

* 1908 omitted, as swedes were grown instead of mangolds. Rape cake

Examination of the plant and experiments with the soil all bear out the results of analysis, and show that the soda has liberated some of the reserve of potash from the soil, and made it more available to the plant.

There must, however, be some other effect produced by sodium salts, because they are beneficial in water cultures whenever the supply of potash is low; and here, of course, there is no question of increasing the solubility of the potash salts. It must, therefore, be supposed that sodium salts are directly useful to the plant, and will fulfil some of the functions of potassium salts, thus eking out a small supply and enabling the plant to make the most of it.

These conclusions have been strikingly verified in an extensive investigation begun by Dr. Wheeler at the Rhode Island Experiment Station of the United States in 1894,* and continued by his successor Dr. Hartwell and his colleagues, the whole forming perhaps the most complete investigation yet made on the subject.

Forty-eight plots were laid out, some receiving a full application of potash, while others had $\frac{3}{4}$, $\frac{1}{2}$, or $\frac{1}{4}$ of the full amount with certain proportions of soda, and others again received no potash at all. A mixture of phosphates and dried blood was applied to all, and a variety of crops was grown. The experiment was continued year after year. Detailed analyses were made in 1906, and the results are fully discussed in the Report for that year;† they have been summarised also in 1913.‡ The sodium salts materially increased the yield of certain crops when the supplies of potassium salts were reduced. They also affected the composition, causing an increase in the percentage of phosphorus in the plant, though this did not appear to be the cause of the increased yield. They seemed to have little or no consistent effect on the percentages of lime or magnesia, or on the ratio of these two substances. They caused no consistent increases in the percentage of potash in the crops, but in some cases even a decrease; the total amount in the whole crop, however, was almost always increased, showing that the soda had increased the supply of potash to the crop. Typical results are given in Table 6. Evidence was also adduced from water culture experiments to show that the soda enabled the plant to utilise more economically the potash it had taken from the soil.

* Wheeler, *Rhode Island Expt. Sta. Report*, 1894, pp. 168–182.
† Wheeler, Hartwell, Kellogg & Steel, *Rhode Island Expt. Sta. Report*, 1906, pp. 186–316.
‡ Hartwell & Wessels, *Rhode Island Expt. Sta. Bull.* No. 153, 1913 (see this *Journal*, August, 1914, p. 441).

TABLE 6.—SODIUM SALTS IN PARTIAL REPLACEMENT OF POTASSIUM SALTS AS FERTILISERS (RHODE ISLAND).

	Turnips, 1905.		Radishes, 1905.		Mangolds, 1899.	
Potash ration	½	½	½	½	½	½
Soda ration	½	1	½	1	½	1
Green weight per plot, lb.	246	372	375	398	421	682
Dry matter contains :—						
Nitrogen, per cent. ..	3·28	2·67	3·87	3·87	1·63	1·75
Phosphoric acid (P_2O_5), per cent.	1·30	1·39	1·03	1·16	·24	·32
Potash (K_2O), per cent.	2·03	2·94	3·21	2·60	1·24	·84

There is one further point that may me commended to experimenters, *although it is not yet ripe to bring before farmers. Certain minerals are obtainable which contain* potash *in a state of rather low availability, e.g., phonolite, certain feldspars, etc.,* some of which have been subjected to a considerable number of field trials without, however, giving any consistently definite result. It is possible that if mixed with salt they might prove more useful.

The various experiments recorded in the preceding paragraphs afford satisfactory evidence that *sodium salts will enable the* plant to carry on without potash fertilisers for a season or two, but before this method can be recommended to farmers it is necessary to enquire whether the sodium salt has any detrimental effect on the soil or the crops.

Salt is *often said to have* a bad physical effect on soils, but there is nothing to indicate that it is any worse than kainit; and *this, as is well known,* only becomes objectionable when used in large quantities on heavy soils. Further, any tendency to stickiness *can be diminished by the use of* superphosphate or sulphate of ammonia.

Mangolds.—All experiments show that the mangold responds to dressings of salt, and there is reason to *suppose that for* a season or two salt could replace most of the potash usually given.

The crop would not be entirely deprived of potash, for a considerable quantity is contained in the dung invariably applied, and the experiments already described make it *reasonably* certain *that the salt would cause* this to be economically used. Numerous English experiments in addition to those at Rothamsted (*Table 5*) *have* proved the value of salt. At Woburn*

* *Jour. Roy. Agric. Soc.*, 1908, Vol. 69, p. 355.

Voelcker obtained good results from dressings up to 6 cwt. per acre. His figures are given in Table 7.

TABLE 7.—MANGOLDS, WARREN FIELD, 1908.

Produce of Roots, tons per acre.

Nitrate of Soda ..	None.	1 cwt.	1 cwt.	1 cwt.	1 cwt.	1 cwt.
Salt	None.	None.	1 cwt.	2 cwt.	4 cwt.	6 cwt.
Sugar Mangolds ..	28·0	30·2	31·3	34·4	34·7	33·9
Golden Tankard ..	19·9	23·4	23·9	29·4	28·9	33·5
Yellow Globe	28·2	33·2	34·9	38·0	38·3	41·2
Long Red	31·8	36·6	32·3	35·2	36·6	36·6

All plots received a standard dressing of 12 tons of farmyard manure, 3 cwt. of superphosphate, and 1 cwt. of sulphate of potash per acre.

In Northumberland, Gilchrist* found that an application of 2 cwt. of salt per acre was beneficial, increasing the yield by some 4 tons per acre. Milburn and Gaut† in Lancashire obtained good returns from 1 cwt. salt. Foulkes'‡ experiments at the Harper Adams College with dressings of 2½, 5, 10 and 15 cwt., respectively, of salt per acre gave the interesting result that the more salt was used the better was the crop, whilst neither the dry matter nor the sugar content of the roots was adversely affected. This last point has been investigated in some detail in Central Europe in the case of sugar beets. The Austrian investigators, Strohmer, Briem, and Fallada,§ obtained increases both in yield and sugar content when sugar beet was manured with salt. So also Andrlík and Urban,¶ and also Mette,** all in Bohemia, found that salt increased the yield without lowering the sugar content: in one experiment the percentage of sugar in the control crops was 20·6, while in the crops treated with salt it was 21·5.

Cereals.—Generally speaking, no potash manure is applied to cereals, but the high prices now obtaining justify more liberal manuring than has often been practised in the past. Wherever land is known to benefit from potash fertilisers a dressing of salt may be tried. Such dressings were not uncommon in the old days of high prices, and their effect is shown in the Rothamsted

* Cockle Park, Bull. 16, 1911, gives 5 years' results. Later results are given in subsequent bulletins.

† Lancashire C.C. Farmers' Bull. No. 19, 1911.

‡ Harper Adams College Report, 1909, p. 14.

§ Oesterr.-Ungar. Zeitsch. Zuckerind., 1908, Vol. 37, p. 763.

¶ Zeitschr. Zuckerind. Böhmen, 1909, Vol 33, pp. 477–485.

** Ibid., pp. 620–621.

experiment quoted in Table 5 (p. 400), where a dressing of sulphate of soda was for many years practically as effective as sulphate of potash, although greater differences subsequently set in. No other British experiments appear to have been recorded. In Yorkshire 2 cwt. of salt per acre added to a complete manurial dressing gave no increase in yield of barley,* but the effect of using salt in place of potash was not tried.

Leguminous Crops.—No large scale experiments appear to have been made to test the effect of sodium salts on leguminous crops, and in the absence of definite information it would not be safe to recommend their use as a means of economising potash supplies; indeed, there is an opinion among practical men that salt is actually harmful to young clover and grasses.

Recourse must therefore be had to another method of setting free the potash reserves, and to this end dressings of lime up to 1 ton per acre, or chalk up to 30 tons per acre, may be used. This method has the further advantage that the lime or chalk acts beneficially in other directions: it keeps the soil in good mechanical condition during winter so that the young plants are not killed by excessive water, and it also prevents "sourness," a condition highly detrimental to leguminous plants generally, and to clover in particular.

The effect of the lime, or chalk, is very marked; often, indeed, it enables a good plant to be secured where otherwise the crop would fail. At Rothamsted the chalked plots this year gave 37½ cwt. of clover hay, while the unchalked gave only 19½ cwt., containing much more weed and grass.

On arable land such dressings may liberate all the potash needed, especially where fairly liberal supplies have been given in the past in the form of potash salts or of farmyard manure.

The method, however, does not always succeed on grass land, especially meadow land that has been persistently hayed. Neither lime nor chalk can take the place of potash; they can only set it free from certain insoluble combinations if it is present in these forms. Where the potash supplies are already very low, there is so little to set free that neither lime, chalk, nor sodium salts have any great chance of being effective. This is shown in the results given in Table 8 for the Park at Rothamsted, where the grass has been cut for hay every year since 1856, and where, therefore, some of the plots have been considerably exhausted. Plot 8, which is poor in potash, is not benefited by lime, while Plot 7, which is better off in this respect, is improved considerably.

* Leeds University, Bull. No. 75, 1909.

TABLE 8.—YIELD OF HAY ON THE PARK AT ROTHAMSTED.

MEAN OF 10 YEARS, 1904–1913.

Plot.	Manuring.	Yield per acre.	Botanical Composition.		
			Gramineae.	Leguminosae.	Other Plants.
		cwt.	per cent.	per cent.	per cent.
4-1	Superphosphate only	18·7	50·6	8·7	40·7
8 N.	Superphosphate + sodium and magnesium salts	23·5	41·6	11·7	46·7
8 S.	Superphosphate + sodium and magnesium salts + lime ..	20·9	49·6	14·4	36·0
7 N.	Superphosphate, potash, sodium and magnesium salts ..	36·8	57·3	20·5	22·2
7 S.	Superphosphate, potash, sodium and magnesium salts + lime	42·8	54·0	30·9	15·1

In such cases potash has to be applied, and this must be done by utilising one of the devices given in the first section of this article: by feeding on the land mangolds or other food-stuffs containing potash; by applying farmyard manure if it can be spared, or some of the ashes or even waste cavings if it cannot; or else by using liquid manure. Hendrick has shown in his recent report* that dressings of liquid manure considerably increased the yield of grass without in any way depressing the clover; indeed, in several of the experiments the clover was markedly benefited.

Potatoes.—In view of the great importance of this crop, it is unfortunate that no reliable method exists for dispensing with potash in the fertiliser scheme. The light loams, the gravels and sands on which potato growing has developed so much in the last twenty years are typically poor in potash, and indeed the industry has only been possible on its present scale since the potash fertilisers came into general use. Most potato growers have probably got a certain reserve of potash stored up in the land, but it is not at all clear how this is best liberated. Lime would do it, but there is a persistent belief among growers that lime encourages scab, and whether true or not it is sufficiently widespread to put this particular method out of the question. Salt or sodium sulphate would also serve the purpose, but it is not clear whether any harmful effect would be produced on the potato. A few experiments have been made, but not in this country. Pagnoul† many years ago found that sodium does

* N. of Scotland Coll. of Agric., Bull. 19, 1915.
† Compt. Rend., 1875, Vol. 80, p. 1010.

not actually get into the tuber, so that no direct injury from this source need be anticipated, but the possibility of indirect effects still remains. Hartwell and Wessels,* in the Rhode Island experiments already mentioned, found that potatoes manured with sodium instead of potassium salts were less mealy when cooked and also contained less ash and more nitrogen. Whether the effects would be of any material significance is uncertain. The fact that many growers use kainit for potatoes suggests that salt could be used without likelihood of harm. Until the actual experiment is tried, however, there is an element of risk, and growers will probably do best to put all the potash fertilisers they can get on to their potatoes, and to supplement them with ashes from hedge trimmings, prunings, etc., as suggested on p. 393.

Conclusion.

The continued lack of potash may be met in two ways:—

(1) Greater care must be taken of the sources of potash already available on the farm: wood ashes, damaged straw, mangold and other leaves, liquid manure, etc., which are often allowed to waste in normal times. These contain considerable quantities of potash which, in the aggregate, would help materially in coping with the present shortage. Moreover, the ploughing up of leys and grass land leads to the liberation of the potash stored up in the roots, stems, and leaves, causing it to become available for the next crop.

(2) On most well-managed farms there are supplies of potash in the soil which can now be made available. Two agencies may be adopted: (*a*) sodium salts, especially salt and sodium sulphate, and (*b*) lime or chalk. The former can be used for mangolds and for cereals when necessary; lime and chalk are more suitable for leguminous crops, clover, etc. There might be some risk in using either for potatoes, and growers would probably do best to put all their supplies of potassium salts on this crop.

Neither lime nor salt actually *supplies* potash, and the method only works where potash is already stored up in sufficient quantity in the soil. On meadow land poor in potash it may prove better to apply liquid manure, as is often done successfully in the North.

† Rhode Island Expt. Sta. Bull. No. 153, 1913.

VILLAGE WAR FOOD SOCIETIES.

IT is probable that the most successful means of increasing the production of all classes of foodstuffs, other than those which can only be produced on small or large holdings, would be the formation of what might be termed "Village War Food Societies." This title is suggested as useful, without reference to "cultivation," because it will cover the *utilisation* and *consumption* of foods as well as their production.

Such societies might often be amalgamated (at any rate for the period of the war) with the local gardening and allotment societies, and they might in some cases cover a group of villages. Even where there are allotments the workers can commonly cultivate much more land than they have, and the necessity and desirability of producing more food of all kinds should be impressed upon each village as a unit. The interest of the women and children should be especially enlisted, as their aid will be of very great importance to the success of any operations undertaken.

Formation.—The formation of a society might be brought about by the Clerk to the Parish Council, who might call a meeting of local residents interested in gardening, pigs, poultry, bees, etc., for the purpose of considering the question of the formation of a local society. This being decided upon, a small committee should be elected (with chairman, secretary, and treasurer of the society) to organise the work of the society on a business footing.

Objects.—The object of each society would be to ascertain the position of vacant building plots, uncultivated "waste" areas, and even some common land; discover the owners and secure permission to cultivate such land (if possible, without charge to the society); arrange either for co-operative and mutual cultivation of the land so secured, and ownership of the produce, or parcel it out to the members to cultivate for themselves individually; secure manures, seeds, plants, stock, foodstuffs, and implements on a co-operative basis, and sell or preserve for home use the produce of their labours.

Advice.—In practically every village sufficient expert knowledge exists to enable the work to be undertaken effectively, but if advice is desired as to the formation of societies a communication may be addressed to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W., or the Secretary, Agricultural Organisation Society, Queen Anne's Chambers, Westminster, London, S.W. Advice may also be obtained through the means outlined in Special Leaflet No. 25

(*Technical Advice for Farmers*); expert advice may be secured in many counties which employ an agricultural and horticultural staff by applying to the County Education Secretary.

Again, leaflets on the growing of vegetables and fruit, pig-keeping, poultry-keeping, rabbit-keeping, bee-keeping, the bottling and preserving of fruit, storage of vegetables, preservation of eggs, etc., can be obtained free of charge and post free on application to the Board of Agriculture and Fisheries. Further, there are in most districts capable gardeners and breeders of small stock (pigs, rabbits, poultry, and bees), both professional and amateur, who would be glad to give the benefit of their experience to persons who require help in this way.

Rules.—A short, concise set of simple and plain rules should be drafted, based on whether the cultivation of the plots is to be individual or co-operative as regards produce. If the work were to be co-operative and mutual all through, the produce would be divided in proportion to the labour and interest of the individual or be pooled and shared equally by the members. Again, actual cultivation might be individual, but seeds, stock, etc., might still be supplied on a co-operative basis. In any case the members would have to subscribe a small sum to get the society started and place it on a secure footing.

In relation to the objects of the societies, they might concern themselves with the lines of production outlined below:—

Growing of Vegetables.—Land should be got ready as outlined in Special Leaflets Nos. 1 (*Suggestions to Allotment Holders for Autumn Treatment of Land*) and 26 (*Suggestions to Allotment Holders for General Cropping during the Spring and Summer Months*), and sowing and planting of the more suitable vegetables should proceed as therein suggested. Potatoes are dealt with separately in Special Leaflet No. 18 (*Potato Growing in Allotments and Small Gardens*), and *The Cultivation of Onions* in Leaflet No. 264. The best means of buying and using the different kinds of manures are fully considered in three leaflets—No. 72 (*Purchase of Artificial Manures*), No. 80 (*Use of Artificial Manures*), and No. 93 (*Farmyard Manure*), and their special application for market garden crops in Leaflet No. 106 (*Fertilisers for Market Garden Crops*).

The land should be thoroughly prepared, bastard-trenched if possible, well manured, limed if necessary (see Leaflet No. 170—*The Use of Lime in Agriculture*), kept thoroughly clean by hoeing (see Leaflet No. 112—*Weeds and their Suppression*), and the crops used or marketed directly they are ready, or stored for use as desired. (See Special Leaflet No. 15—*Harvesting and Storing of Garden Vegetables*.)

Goat-keeping.—In rural districts there is usually scope for the keeping of goats, which may be housed and fed fairly cheaply. If care is used in their selection and treatment, they will yield a good return in the form of wholesome milk for the owners. Co-operation among members of a village society may have excellent results in connection with goat-keeping. An article on goat-keeping was published in the *Journal of the Board of Agriculture* for March, 1908, and the Board propose shortly to publish a further article and issue a leaflet on the subject.

Pigs.—In connection with many cottage gardens, and on vacant areas, pig-keeping could be practised much more commonly than at present, and the society should endeavour to increase the local output of pigs. Pig-keeping could readily be conducted on a co-operative basis, and there would be large quantities of waste vegetable matter which would be of very great value for this purpose. Notes which would be of use to the members of the society in connection with the rearing of pigs are given in Special Leaflet No. 10 (*Pig-keeping for Cottagers and Small Holders*).

Poultry.—Every additional egg, and every extra chicken reared will help the food supply, if produced under proper conditions, and there is at the present time special need to increase the numbers of both eggs and poultry. Any reduction in the laying or breeding stock of poultry kept is against the best interests of both the individual and the nation, and each society should do all it can to extend poultry-keeping in its district—again, either by individuals or collectively by co-operation. The number of persons who could readily keep poultry is very great, and a few birds kept by each would not only enable them to utilise much household and garden "waste," but to utilise it in the economic production of eggs and table birds, and add to the resources of the country. The Board have issued a number of leaflets on poultry, and attention may be drawn to Special Leaflet No. 3 (*Poultry on Allotments and Garden Plots*), Special Leaflet No. 2 (*Notes on Poultry Feeding*), Special Leaflet No. 11 (*Poultry Houses and Appliances for Allotment Holders, Cottagers and others*), Leaflet No. 114 (*Feeding of Poultry*), Leaflet No. 129 (*Winter Egg Production*), Leaflet No. 201 (*The Marketing of Poultry*), and Special Leaflet No. 13 (*Marketing of Eggs*).

In some districts where there are fairly large areas available, such as commons, it may be possible to take up the co-operative rearing of turkeys (see Leaflet No. 229—*The Breeding and Rear-*

ing of Turkeys) and geese (see Leaflet No. 198—*Rearing and Marketing of Geese*), while ducks can even more commonly be bred and fattened (see Leaflet No. 167—*Ducks and Duck Breeding*). Suggestions for co-operative effort are made in Leaflet No. 111 (*Co-operative Egg and Poultry Societies*).

Preservation of Eggs.—While it may often be desirable and profitable to sell the eggs produced when new-laid, the societies may usefully consider whether their members cannot act in concert, purchase jars and materials in bulk and preserve eggs for future use. By this means it may be possible for a small district or village to put by some thousands of eggs during the "cheap" season for use when eggs are dear, and so save the meat bill. The more useful means by which eggs may be preserved are described in Leaflet No. 83 (*Preservation of Eggs*).

Rabbit Breeding.—There is plenty of opportunity in every village for increasing the food supply by means of rabbit breeding, the produce being utilised either for home consumption or for increasing home resources through the medium of the market. Some notes on *Utility Rabbit Breeding for Small Holders* are given in Leaflet No. 265, and the Board propose to issue a second leaflet on the subject at an early date.

Pigeon Breeding.—A further means of increasing production lies in the breeding of young pigeons. Little equipment is necessary—none that cannot readily be found in every village, as cotes and wire enclosures can be made by any man who is handy with tools. The birds need little attention if they can be allowed their freedom, and will rear several brace of youngsters annually. The "squabs" may be killed at about 8 weeks old, and before that time is up the old birds will be incubating a further pair of eggs. The Board hope to issue shortly a leaflet on the breeding of utility pigeons.

Bees.—There is always a satisfactory outlet for good honey, which is a valuable article of food, and it should be especially welcome at a time when sugar is so dear. The Village War Food Society might very usefully endeavour to extend bee-keeping in the district. Apart from the fact that, so long as freedom from disease can be secured, the production of honey is an inexpensive and remunerative village industry when the honey is for sale, the honey may, if retained for home use, effect a considerable saving in sugar. Bee-keeping is dealt with in two of the Board's Leaflets, No. 128 (*Advice to Beginners in Bee-keeping*) and No. 141 (*Preparation of Honey for Market*). Co-operative bee-keeping would almost certainly be of value, and could be more economi-

cally and successfully conducted than individual work. Hives placed in separate gardens could still remain part of a co-operative plan, and the running, packing and marketing of the honey could be done at one house and with one set of appliances, while the management of the hives could be more readily and effectively controlled.

Preservation of Fruit.—In normal years there is usually considerable waste of fruit throughout the country. Village War Food Societies should strive to ensure that all fruit in their district is properly utilised. When in season fruit will materially aid in reducing the meat bill, and is a wholesome, health-giving food. Any fruit, however, which is not consumed fresh, or is not marketed, should be stored or preserved in some way for future use. Apples and pears may be stored in cool rooms, and soft fruits may be bottled or converted into jam, or be dried. *The Storage and Disposal of Apples and Pears* is dealt with in Special Leaflet No. 6, which shows when the fruit should be gathered, describes a useful store, and also grading for market. Members of societies might materially reduce individual costs of storing and preserving if they worked co-operatively, buying materials, etc., wholesale, bottling and preserving the members' fruit in the same way. Leaflet No. 250 (*Fruit Bottling for Small Holders*) shows clearly how bottling may be effected, and Special Leaflet No. 5 deals briefly with *Fruit Preserving for Small Market Growers or for Domestic Use.* The quantity and quality of fruit in the season 1916 might well be very much improved if the proposed societies would again work on a co-operative basis to prune, spray, and otherwise tend the fruit trees in the district, whether in orchards or small gardens. *The Pruning of Fruit Trees* is discussed and described in Leaflet No. 252, while Leaflet No. 70 deals with the *Winter Washing of Fruit Trees and Treatment of neglected Orchards. The Grading and Packing of Fruit and Vegetables* generally are dealt with in Leaflet No. 98.

Collection of Wild Fruits.—Another matter which the societies might well take in hand is the collection of wild fruits and their sale or preservation for home use. Blackberries, wild raspberries, cranberries, whortleberries, crab apples, and hazel nuts may all be collected in considerable quantity in different districts, and all add appreciably to the food resources of the collectors. The children should be induced to take up this branch of work, and the collected fruit may be sold, or bottled, or

Gleaning.—Co-operative "gleaning bees" for the women and children might add largely to the food of villagers, and the collected grain could be pooled and divided among the gleaners, or be valued and divided according as to whether one desired wheat, another barley, etc. Some families might quite well have the benefit of a sack or more of wheat, which could be ground for their use locally. Here again grinding might be done in one operation for all the members of the society.

Collection of Acorns, &c.—It has not been sufficiently recognised that acorns, horse chestnuts and beech mast are all useful foods for stock, especially acorns. The village societies should do all that lies in their power to utilise these products to the full. They may readily and quickly be collected by children, and even when not required for the stock owned by members, may doubtless be disposed of to neighbouring farmers. An account of the *Food Value of Acorns, Horse Chestnuts and Beech Mast*, is given in Special Leaflet No. 9.

In all rural districts are to be found spots carrying considerable amounts of rough grass and green herbage, nettles, etc. General collection of such material may result in the ownership of a useful quantity of rough hay, which may be picked over by the goat and used generally for the stock, either for food or litter. It may be possible to make it into silage with other green stuff, as described in Leaflet No. 9 (*Ensilage*).

NOTE.—Town or Urban War Food Societies might be formed on somewhat similar lines to the Village War Food Societies referred to above, but their sphere of activity would probably be largely restricted to gardening operations. Both types of societies should not only deal with increased production, but with the economic utilisation, preparation and consumption of foods in each individual home.

CO-OPERATIVE FARM IMPLEMENT SOCIETIES.

T. WIBBERLEY, N.D.A., N.D.D.,
Agricultural Expert to the Irish Agricultural Organisation Society.

THOUGH the war has caused an advance in the price of farm produce, and would therefore lead to an increase in the arable area, it should be borne in mind that it has also brought about a great shortage of manual and horse labour on the farm. As a consequence of this fact, the difficulties of the arable farmer have greatly increased.

The shortage of both kinds of farm labour could undoubtedly be overcome by the use of labour-saving implements on a more extended scale. Except on very large farms, however, the introduction of such machinery presents another difficulty; farm machinery is very costly, and average farmers of medium-sized and small farms have not sufficient capital to purchase the necessary machinery for a large extension of their tillage area.

This statement is specially true of Irish farmers, and, realising this difficulty, the writer a few years ago devised, under the auspices of the Irish Agricultural Organisation Society, a co-operative farm implement scheme, through the operations of which it has been possible to place practically every farm implement, from a one-horse plough to a high-power agricultural tractor, at the disposal of farmers who become members of the co-operative implement societies which are formed. Further, the implements have been made available to farmers by the use of a merely nominal amount of capital on the part of the individual farmer.

How far co-operation on the lines indicated is possible under English farming conditions it is for the English farmers to decide, but it will probably be of interest to them to learn what their Irish contemporaries have done in this direction, and also to get an insight into the details connected with the formation of co-operative farm implement societies.

Before giving these details, however, it will not be out of place to put before the reader a few statistics, showing how the operations of co-operative implement societies have resulted in an increase in the tillage area. In connection with these statistics it may be remarked that the co-operative farm implement scheme has only been in operation amongst

Number of Members of four Co-operative Farm Implement Societies, and the Tillage Increase amongst them for the years 1913–15.

Society.	Number of Members.	Total area in Tillage for each Society. Acres.			Average Increase per Member. Acres.
		1913.	1914.	1915.	
Meenahela, Co. Limerick	21	73	104½	158½	4·1
Killeedy, Co. Limerick	20	122	140	176	2·7
Menlough, Co. Galway	64	454¼	519	683¼	3·6
Fourmilehouse, Co. Roscommon	32	94	106	153	1·8
Totals	137	743¼	875½	1,171	—
Averages ..	34	186	219	293	3·12

the four societies mentioned since the spring of 1913, and that these societies are by no means specially selected, except in so far as they are all situated in very poor districts, and amongst farmers whose capital is very limited, and whose holdings average about 30 statute acres.

These figures are all the more striking when it is realised that in Ireland 85 per cent. of the farms are not over 50 acres, and that at present only 12 per cent. of the available land in the country is under the plough. Had the average Irish farmer increased his cultivated area in the same ratio as the members of the societies mentioned above, during the period referred to, the result would have been an increase of over 1½ million acres under the plough.

The Formation of a Co-operative Farm Implement Society.—When it has been decided by a community of farmers to start a co-operative farm implement society, a general meeting is held by those interested in the project. At this meeting, with the help of a co-operative organiser (who always attends for the purpose) the following matters are dealt with :—

(1) The formation of a Committee, consisting of a Treasurer, a Secretary, and about nine ordinary members.

(2) The drafting of general rules for the future government of the Society.

(3) The financing of the Society.

(4) The drafting of by-laws in accordance with which the Society's implements are let out on hire.

The committee are empowered to raise the necessary capital for the financing of the society, and to transact all business appertaining to the society.

The first duty which the committee must undertake is the registration of the society in accordance with the requirements of "The Industrial and Provident Societies Act." This is necessary in order to give the society a legal standing. Registration is effected by forwarding to the Registrar appointed in connection with the Act a copy of the proposed rules of the society, stating the objects and name of the society. Application is made on a prescribed form by the members of the committee, on behalf of the society.

The legal fee for registration is £5, but if the application is sent to the Registrar *via* the Central Office of the Irish Agricultural Organisation Society the fee is reduced to £1. The cheaper rate of registration is obtainable in view of the greater ease with which the Registrar can deal with the application, after this, together with the draft rules, has been submitted to the scrutiny of the experts employed by the Central Organisation Office.

Assuming that the rules, etc., are in accordance with the requirements of the Act mentioned above, the society is duly registered and the committee are so informed. The committee are now in a position to set about raising the necessary capital to finance the society.

Capital.—The capital is invariably obtained in the form of an overdraft from the local branch of a joint stock bank. The committee act as guarantors for the amount of the overdraft, and are thus directly responsible to the bank for the security of the amount involved.

On the other hand, each shareholder in the society signs a form making himself responsible to the committee for the payment of his shares in full, in the event of the society meeting with financial disaster. The object is to make every individual shareholder financially responsible, and since the overdraft is not greater than the amount of shares allocated, the committee are guarded against any financial risks. As a rule £1 shares are issued, and each member is obliged to take at least the minimum number of shares specified by the

committee, and also pay on each share at the time of allocation whatever amount the committee decide.

As a rule each member is required to take at least five £1 shares and pay on allocation the sum of 2*s.* 6*d.* per share. The rate of interest charged by the joint stock bank to a co-operative society is very low, usually 4 per cent., and it should be understood that interest is charged only on the amount of the overdraft which the society actually has in use ; that is to say, if a permissive overdraft of £500 has been obtained, and only £200 is used, interest is only charged on the latter amount.

Hiring of Implements.—The by-laws controlling the rates and terms of hire of the society's implements are framed—again with the expert assistance of an officer of the Irish Agricultural Organisation Society—to meet the specific requirements of the particular district.*

As a general rule, the implements are hired out in the order in which applications for them are made by the members, but since the main object is to encourage tillage, precedence in the use of an implement is given to the member who wishes to use the implement for the longest period. That is to say, if on the same day two men require the use of a corn binder, one having 10 acres of corn and the other 2 acres, the former takes precedence, and so on with all other implements. If in the case mentioned a second binder is not available, then the applicant with 2 acres of corn has no alternative but to harvest his crop in the ordinary manner, that is, with an ordinary manual reaper and in some of the poor districts with a scythe. Such action gives an opportunity for the display of one of the finest features of the co-operative movement, viz., the exercise of private co-operation amongst the members themselves. For example, in the case referred to the farmer who has been fortunate enough to secure the use of a corn binder, requiring at the most only one other manual helper for the harvesting of his crops, would in most cases come to the help of his fellow farmer by lending to him those of his own workers whose help is not immediately required for the saving of his own corn. It may also happen that a farmer with only a small amount of tillage may be debarred from the use of several implements, and one might be surprised that such a farmer persists in remaining a member.

* A memorandum containing suggestions for the formation of farm implement societies and the framing of by-laws may be obtained on application to the General Secretary, Agricultural Organisation Society, Queen Anne's Chambers, Tothill Street, Westminster, London, S.W.

In actual practice, however, it usually happens that the farmer who requires the use of expensive farm machinery himself possesses the cheaper implements, and thus does not require to hire such implements from his society; in consequence the cheaper implements are more at the disposal of the smaller and poorer farmers, who individually cannot afford to buy them.

Further, the greater the amount earned by the machinery the stronger the financial position of the society becomes and the sooner more implements can be purchased. As will also be readily understood, the greater the demand for any particular type of implement the more of such implements are purchased by the society.

As a general rule, the rate at which the implements are hired out to members of the society is about half of what it would cost to carry out the various operations under the old regime. If, for instance, potato sorting by hand costs 15*s.* per ton the potato sorter is hired out at 7*s.* 6*d.* per ton. If corn binding with the manual reaper costs 15*s.* per acre, then the combined reaper and binder is hired out at 7*s.* 6*d.* per acre. Again, if the ploughing of stubbles by horse labour costs 10*s.* per acre, a double disc harrowing with the agricultural tractor (which tills the land more effectively) is undertaken at the rate of 5*s.* per acre. In the case of corn threshing the usual rate is ½*d.* per stone threshed.

Implements for Nothing.—Apart from the great saving effected in the cultivation of land and the harvesting of the crops through the operations of an implement society, it is remarkable how soon a well-conducted society can earn sufficient to pay for the initial cost of the implements. Many instances are on record where a society commencing with two binders has in one harvest earned sufficient to purchase a potato digger. The potato digger has gone out on hire, and in its first season has earned sufficient to buy a corn drill, which in like manner has earned the price of a horse-power sprayer, and so on. It is usually in such a small way as the preceding that a society commences its operations. Once the farmers of a district recognise the utility of such a scheme the membership increases very rapidly. Automatically the society's borrowing powers increase, and it is then in a position to undertake the purchase of the more expensive implements, such as agricultural tractors and complementary implements, combined threshers and finishers, and mole-draining plants.

POLLINATION OF FRUIT TREES: OBSERVATIONS AND EXPERIMENTS from 1904 to 1912.

W. J. MIDDLEBROOKE.

THE theory of pollen sterility, *i.e.*, the inability of certain varieties of fruit to fertilise themselves and produce fruit, has not yet been completely established. The few experiments that have so far been carried out have not proved that any particular pollen can be said to be absolutely sterile, and they can only be regarded as a preliminary to further experiments and research. Before the theory of pollination can be made of any practical benefit to the fruit grower, many more experiments, requiring much time and patience, must be carried out in a methodical and continuous series.

The magnitude of such an undertaking must be apparent. The facilities for carrying out experiments of this nature do not exist in private gardens or even nurseries, where other work must always be the first consideration; the work can only be successfully accomplished in a properly equipped research station by a staff of experts. The problem is rendered more complex by the ever-increasing number of varieties of fruits. To make a comparison of all the varieties in cultivation, each with the rest, would be an appalling task, and any attempt to conduct experiments on such a scale would almost certainly be unsuccessful.

It is admitted that some varieties produce pollen more potent than other varieties of the same kind; it is also admitted that the mixing of varieties is beneficial in securing larger crops, and that being so, we have a very good foundation on which to build future research schemes and experiments. The first step is the collection of evidence to determine the most prolific varieties, *i.e.*, those which are likely to give the best results when used for pollination purposes; the next, to test the potency of the pollen of these varieties on shy-bearing varieties. The latter are in a minority, but, unfortunately, include some of the best flavoured and highest quality varieties, such as Ribston Pippin apple, which would become valuable to the market grower if an average crop could be secured.

It is the unsatisfactory cropping of many varieties of fruit that has led to the investigations into the relative potency of the

pollens of different varieties. Sterility cannot be attributed to close in-breeding: most of the varieties of fruit trees in cultivation originated in chance seedlings, the parentage of which is unknown, and little effort has been made to produce strains or fixed types of fruit trees as in the case of flowers and vegetables. Neither can sterility always be attributed to impotent pollen; many other agents may be responsible for the destruction of fruit crops during the flowering period.

The interest of the writer in the problem was awakened in the spring of 1906, in consequence of some failures, and partial failures, in securing satisfactory crops of fruit on some special varieties, on trees grown in pots for exhibition purposes. The failures occurred only with a few varieties, some of which were most desirable for exhibition, on account of their handsome appearance and good quality. At that time the pollination was carried out by means of hand brushes, the pollen being collected without regard to the selection of any special varieties. This system of pollination being only partially successful, further observation and experiments were made. Pollen was selected from a number of varieties of a decidedly free-bearing and free-setting nature. While doing this it was noticed that some varieties produced a much greater quantity of pollen than others. These freely pollen-producing varieties were extensively used for pollinating purposes with a conspicuous success which gave an impetus to further experiments, on a larger scale, with a larger number of varieties. The succeeding experiments were carried out in a more methodical manner, and the results were recorded for reference, with a view to the revision, if necessary, of the varieties to be used in future pollen experiments. At this stage of the experiments the system adopted for the collection of pollen was to use one brush for one variety, labelling the brush with the name of the variety from which the pollen was taken; the pollen was then applied to the varieties chosen for the application of this particular variety of pollen, the pollinated tree being labelled with the same name as the brush containing the pollen.

Pollination by Bees.—In 1910 a stock of bees was introduced into the orchard house where the trees were grown for half the season, that is through the flowering period, until the fruit was three-parts matured, when the trees were transferred to the open air to finish. The bees were introduced mainly for the purpose of pollinating currants and gooseberries, it being found impossible to do this effectually by artificial means. The bee experiment

was also a failure as far as the currants and gooseberries were concerned; the bees ignored them, and preferred to feed on the honey remaining in the hive. The bees were allowed to remain in the orchard house until the other kinds of fruit trees flowered, a portion of the trees being left unprotected for them to work upon, in order to ascertain what results bee pollination would show. The results of bee pollination were not nearly so good as those obtained by artificial pollination, but this may have been due to too many kinds of fruit being in bloom at nearly the same time. Apricots, peaches, and nectarines were the first to open flowers, and the bees worked among them well, until the cherries and plums came into flower, when they preferred the latter, and left off working the former; the same thing happened when the apples and pears came into bloom. From observations made during the experiment, it was clearly shown that the bees worked newly opened flowers for honey collection, and they did not appear to collect pollen at the same time; pollen was apparently collected separately, or by special bees. It was noticed that when alighting at the entrance to the hive some of the bees were loaded with pollen, while others had none so far as could be seen.

Very few other insects visited the flowers, and in all probability did little, if anything, towards distributing pollen. Exception must, however, be made with regard to bumble bees, a number of which were continually at work; a small dark-coloured species of bumble bee appeared very early in the season, and worked incessantly during periods of sunshine, and often on dull days when the atmosphere was warm. These small bumble bees began work earlier in the day than the hive bees and continued working later at night; they did the work of pollination very effectively. Flowers which were marked as being visited by the bumble bees were found to be effectively fertilised, the flower petals falling two days after their visit. The bumble bees did not appear to collect pollen and carry it away, but a small quantity of pollen adhered to their legs and the hirsute covering of the lower part of their bodies, thus ensuring cross-pollination.

Pollination was most effective on days with intervals of cloud and sunshine (typical of April weather) with a warm and slightly humid atmosphere. On dull, cold days and abnormally hot days pollination was ineffective. The rapid evaporation on hot, sunny days caused the foliage to flag, and the flowers to become limp, with the result that the vitality of the trees was lowered for

the time being, and the trees prevented from performing the necessary functions for effective fertilisation.

Pollination by Wind.—Experiments on pollination by wind were also tried; the wind was simulated by the use of bellows, and by shaking the trees. This method of pollination produced good results: it was also noted that out-door fruit set more freely with gentle breezes of wind and occasional showers of rain, and a sufficiently warm atmosphere.

The trees for test purposes were isolated by means of muslin screens on a framework of light canes. Suitable trees of small size were selected for the purpose, and a uniform number of fruit buds were left on each tree. As the flowers opened the anthers were removed from those to be fertilised, thus ensuring a correct test. The pollen was applied as soon as the flowers were sufficiently developed and the female organ in a receptive condition.

Value of Results Obtained.—The results of these experiments were very successful from a practical point of view, as only about 5 per cent. of the trees failed to set a sufficient quantity of fruit for a crop, and no trees were entirely barren.

The tabulated figures given below plainly indicate that there is greater possibility of securing good average crops of fruit where a number of different varieties are grown in proximity to each other.

It has been the practice of commercial fruit-growers in recent times to plant large blocks of one variety which makes a good price in the market. In doing so they have overlooked the possibility of loss of crop from ineffective pollination. In the county of Kent it is the custom to plant two rows of male hops, for the double purpose of protection from wind, and to fertilise the female or fruiting hops. Growers also plant filberts among cob nuts to assist in the work of pollination, the filberts producing a greater profusion of male catkins than cob nuts, and a better crop of nuts is ensured. Yet they have overlooked the necessity of doing the same thing with fruit trees. The policy of planting large blocks of one variety of fruit has no doubt necessitated the regrafting of a large acreage of apples and pears, the grubbing up and replanting of many acres of plums, and the discarding of many excellent and valuable varieties of all kinds of fruit.

The figures given in connection with this article cannot be regarded altogether as final, but only as a step in the right

direction of obtaining satisfactory evidence of a nature which will be of practical value to the grower. To obtain full and satisfactory information on this subject it is desirable that future experiments should be conducted in the open air under natural conditions.

From the tabulated figures given, a casual observer, unacquainted with this kind of experimental work, may think that the average results obtained show a very low percentage, but as a matter of fact the percentage was higher than was anticipated or could be expected, seeing that every flower in each truss of bloom was taken into account. No thinning was carried out, as this would have led to exaggerated results. The average number of flowers in a truss of the different kinds of fruit are roughly as follows: Apricots, 3 to 5; apples, 5 to 7; cherries, 15 to 25; nectarines and peaches, 2 to 5; pears, 9 to 12; plums, 3 to 9. Apricots, nectarines, and peaches produce a quantity of flowers singly, disposed alternately on the shoots or at intervals between triple buds, the centre bud being a growth bud. On extra vigorous shoots three to five flower buds are formed in a cluster round a growth bud. It will be seen from the number of flowers contained in a truss or bunch that it is impossible or unlikely that every flower will set and develop fruit; it was invariably found that the first flowers of a truss that opened were fertilised and began to swell immediately, while the remaining flowers of the truss, although they may have been duly pollinated, did not swell; the stalk and embryo fruit turned yellow and fell off.

The number of fruits developed on each truss vary with the variety. In apples the small and medium sized fruited varieties matured the greatest number per truss, sometimes producing as many as six fruits in one cluster; the large fruited varieties rarely retained more than one or two fruits in a bunch, although sometimes three were matured. Pears, except some of the larger fruiting varieties, which rarely matured more than three in a cluster, carried more fruit per bunch than apples. Cherries and plums are more variable than apples and pears; in favourable seasons the amount of fruit set and retained was enormous, and required considerable thinning, otherwise the fruit was small, and the trees were impoverished.

Experiments with Cider Apples.—Experiments with the pollen of cider apples were made, but not on a large scale; the results were satisfactory in the majority of the tests. Observations made in connection with orchards of cider fruit

and mixed orchards, in the county of Hereford, showed that cider varieties cropped more heavily and with greater regularity than culinary and dessert apples, and that, where culinary and dessert apples were intermixed with cider apples, better crops were obtained. One instance may be mentioned. In an orchard at Cubberley, near Ross, the following apples were growing among cider apples, viz., Blenheim Orange, Bess Pool, Ribston Pippin, Catshead, and several other varieties, all of which were heavily laden with fruit, the fruit hanging on the branches like ropes of onions, bending the branches until the tips of them touched the ground. Similar results were noted in orchards all over the county, where other varieties had been planted among cider varieties.

From observations and experiments made, it is suggested that, at any rate in grass orchards planted with standard trees, cider varieties planted among culinary and dessert apples would have a beneficial effect on the cropping of the latter. Cider varieties worked on Paradise stocks could be tried in plantations of bush trees. The varieties of cider apples experimented with were early flowering varieties; the bulk of cider apples flower late, consequently they would not be serviceable for the pollination of the majority of culinary and dessert apples.

The following varieties of early flowering cider apples were tried and are recommended; the flowering period is indicated in brackets:—Bedan des Parts (April), Cherry Hereford (middle May), De Boutteville (early May), Eggleton Styre (middle May), Handsome Hereford (middle May), Medaille d'Or (early June), Rouge Bruyere (early May), Sam's Crab (April)—(a good dessert eaten from the tree), Skyrme's Kernel (end of May), Strawberry Hereford (middle May), White Hereford (early May). All the above-mentioned varieties are extremely prolific.

Form of Fruit Tree Suitable for Pollination Experiments.—The best form of tree for pollination experiments is the single cordon, which should be grafted, or better budded, on suitable stocks. Single cordon trees occupy less room than pyramids or bush trees; they are more easily protected and isolated, and much easier to manipulate, either as pot plants or grown in the open ground. The apple should be worked on the broad-leaved English Paradise, pear or quince, and some varieties double grafted; plums on common plum and broad-leaved Mussel; cherries, Dukes and Morello on Mahaleb and other varieties on Avium; nectarines and peaches on Brompton and broad-leaved Mussel; and apricots on Brussel, Brompton and broad-leaved

Mussel. Some varieties of stone fruit do better on one stock than another; it is therefore important that each variety should be worked on the stock best suited for it.

Experiments with grapes proved that, with the exception of Muscat Hamburgh, which showed a preference for the pollen of Black Alicante or Black Hamburgh, there was a tendency for the pollen of all varieties to set freely. The cause of bad setting in such varieties as Alnwick Seedling, Duke of Buccleuch, Mrs. Pince, Black Muscat, and White Muscat, was found to be the presence of a little drop of nectar hanging on the end of the pistil, which prevented the pollen from doing its work. The obstacle being removed there was no difficulty in securing a thickly set bunch of berries. The method adopted for the removal of the nectar obstacle was to syringe the bunches early in the day with clean warm water at a temperature of 5° F. above that of the house in which the grapes were growing; the water was driven through the bunches with some considerable force, and was projected in as fine a spray as possible; later in the day, when the bunches were dry, the hand was gently drawn down the bunches, which were afterwards shaken. Pot vines treated in this way were exhibited with as many as fifteen good-sized bunches, well packed with berries.

In the case of the currant and gooseberry tests under glass, the best results were obtained by placing the bushes in a position where they were more exposed to wind from the ventilators, and where a cooler temperature could be maintained. No difficulty was experienced with them when grown out of doors, except that they required protection from frost.

NOTE.—In the following list many varieties will appear which are not of direct interest to the commercial grower. On the other hand, most of them are grown by the professional gardener and the amateur. The tables will therefore be of interest to them, as affording a guide to possible pollinisers which they may have growing, and which, in the case of trees of more or less self-sterile varieties, it would pay them to use for artificial pollination.

Tables showing Results obtained with different Fruits by Cross-Pollination as compared with the Pollination by the Varieties' own Pollen and Mixed Pollen taken from various Varieties indiscriminately.

The names at the head of the columns indicate the varieties used for pollination. The figures given in the columns represent the percentage of fruit set and remaining on the trees at the time of thinning, the fruit being of considerable size and securely fixed. The results are from experiments carried out for five years in succession, *1907 to 1912*. The trees were established in pots and fruited under glass without artificial heat.

APPLES.

VARIETIES.	Own Pollen.	Mixed Pollen.	Allington Pippin.	Beauty of Kent.	Belle Pontoise.	Bismarck.	Cellini.	Cox's Pomona.	Devonshire Quarrenden.	Dutch Mignonne.	Golden Spire.	James Grieve.	Jonathan.	King of Tompkins County.	Kings Acre Bountiful.	Margil.	Newton Wonder.	Scarlet Nonpareil.	The Queen.	Washington.	Wealthy.	Worcester Pearmain.
Adam's Pearmain	5	10	—	—	—	12	—	—	—	15	—	—	17	21	—	—	—	9	—	—	—	—
*Allington Pippin	15	20	—	—	—	15	—	10	—	12	—	22	—	—	—	17	—	21	—	—	—	—
American Mother	7	12	17	—	—	—	—	—	—	20	—	18	14	—	—	20	—	18	—	—	—	—
Annie Elizabeth	5	9	—	—	15	17	—	10	—	—	—	—	—	—	15	—	12	—	13	—	—	—
Astrachan Red	8	12	—	—	—	—	15	—	17	—	—	—	—	—	—	—	—	—	—	—	—	12
*Baumann's Red Winter Reinette	10	15	12	13	—	13	—	—	—	—	—	—	15	—	—	—	12	—	—	—	—	—
Beauty of Bath	3	9	—	—	—	—	17	—	16	—	—	12	—	—	—	—	—	—	—	—	—	10
*Beauty of Kent	9	12	—	—	20	22	—	19	—	—	—	—	15	—	20	—	—	—	16	—	—	—
*Belle Pontoise	12	15	—	17	—	20	—	15	—	—	—	—	—	17	—	—	21	—	22	17	—	—
Ben's Red	6	12	18	15	—	—	16	10	17	—	—	—	13	—	—	—	—	—	—	—	13	—
*Bismarck	12	16	—	19	22	—	—	17	—	—	—	—	—	25	—	—	15	—	20	—	—	—
Blenheim Orange	5	12	—	12	—	18	—	—	—	—	—	13	—	20	—	—	14	—	—	19	—	—
*Bramley's Seedling	9	17	—	—	22	—	—	—	—	—	—	—	—	15	21	—	21	—	14	—	—	—
*Cellini	12	22	—	14	—	25	—	15	—	—	—	—	—	—	18	—	—	—	15	—	—	—
Charles Ross	3	12	—	—	16	—	10	12	—	—	—	7	—	15	—	—	13	—	—	—	9	—
*Christmas Pearmain ..	10	14	15	—	—	—	—	—	—	20	—	—	—	—	—	15	—	23	—	21	—	—
Cornish Aromatic	6	13	—	—	—	—	—	—	—	19	—	—	17	—	—	10	—	16	—	—	—	—

* Denotes free pollen bearers.

APPLES—*continued.*

VARIETIES.	Own Pollen.	Mixed Pollen.	*Allington Pippin.*	Beauty of Kent.	Belle Pontoise.	Bismarck.	Cellini.	Cox's Pomona.	Devonshire *Quarrenden.*	*Dutch Mignonne.*	Golden Spire.	James Grieve.	Jonathan.	King of Tompkins County.	Kings Acre Bountiful.	Margil.	*Newton Wonder.*	Scarlet Nonpareil.	The Queen.	Washington.	*Wealthy.*	Worcester Pearmain.
Cornish Gilliflower	3	10	9	—	—	—	—	—	—	—	—	—	12	—	—	7	—	12	—	—	—	—
Coronation	7	12	—	18	—	17	—	15	—	—	—	—	7	—	—	—	—	—	—	12	—	—
*Court Pendu Plat	15	15	—	—	—	—	—	—	—	25	—	—	17	—	—	—	—	21	—	—	16	—
*Cox's Orange Pippin	9	15	22	15	—	17	—	12	10	20	—	20	19	16	—	15	—	25	—	17	15	15
*Cox's Pomona	10	17	—	12	—	19	—	—	—	—	—	—	—	15	—	—	—	—	20	13	—	—
*Crimson Queening	7	12	—	—	—	—	—	—	—	—	—	15	—	—	—	—	—	—	—	17	10	13
*Devonshire Quarrenden ..	12	15	—	—	—	—	—	—	—	—	—	17	—	—	—	—	—	—	—	—	—	20
*Duchess of Gloucester ..	10	17	15	—	—	—	—	—	19	—	—	13	—	—	—	—	—	—	—	—	—	18
*Duchess of Oldenburgh ..	9	15	—	—	—	15	19	—	—	—	17	—	—	—	23	—	—	—	16	—	—	17
*Dutch Mignonne	12	14	—	17	—	18	—	—	—	—	—	—	21	—	—	15	—	20	—	—	—	—
Ecklinville Seedling	3	10	—	—	—	—	12	—	—	—	19	—	—	—	22	—	—	—	15	—	—	—
Egremont Russet	7	12	22	—	—	—	—	—	—	15	—	—	18	—	—	14	—	21	—	—	—	—
Emperor Alexander	6	12	—	18	18	21	—	17	—	—	—	—	—	20	—	—	—	—	19	23	16	—
*Frogmore Prolific	15	20	—	—	—	—	—	—	—	—	21	—	—	—	25	—	—	—	18	—	—	—
Gascoigne's Scarlet Seedling	9	14	—	17	—	20	—	17	—	—	—	—	19	—	—	—	17	—	—	—	20	—
Gloria Mundi	4	12	—	—	15	—	—	13	—	—	—	—	—	12	—	—	15	—	14	—	—	—
*Golden Spire	13	17	—	—	—	—	20	—	—	—	—	15	—	—	25	—	—	—	—	—	—	—
*Grenadier	12	18	—	—	—	16	13	—	—	—	—	—	—	—	19	—	—	—	—	—	—	—
*Hambling's Seedling ..	2	7	—	—	—	12	9	7	—	—	—	—	—	—	—	—	12	—	8	—	—	—
Hawthornden	5	12	—	—	10	7	—	15	—	—	—	—	—	—	13	—	9	—	—	—	—	—
Hollandbury	7	12	—	10	—	—	—	12	—	—	—	—	—	—	—	—	15	—	17	—	—	—
Irish Peach	10	13	—	—	—	—	—	—	17	—	—	—	—	—	—	—	—	—	—	—	—	12
*James Grieve	12	15	17	—	—	15	—	—	18	—	10	—	—	—	16	—	—	19	—	21	—	19
*Jonathan	10	17	12	—	—	14	—	—	—	20	—	—	—	17	—	—	—	15	—	19	—	—
*King of the Pippins	9	17	20	—	—	—	—	—	—	—	—	17	15	—	—	—	—	19	—	—	16	—
*King of Tompkins County ..	7	12	—	10	—	17	—	7	—	—	—	—	15	—	—	—	18	—	—	20	13	—
*Kings Acre Bountiful ..	17	21	—	—	—	—	15	12	—	—	20	—	—	—	—	—	—	—	17	—	—	—

*Kings Acre Pippin	9	15	—	—	—	—	—	—	—	19	—	—	21	—	—	—	—	12	—	17	—	—
Lady Sudeley	7	13	—	—	—	—	—	—	17	—	—	20	—	—	—	—	—	—	—	15	—	15
*Lane's Prince Albert ..	10	15	—	—	17	15	—	—	—	—	—	—	—	—	19	—	16	—	9	—	—	—
Langley Pippin	5	12	—	—	—	—	—	—	15	—	—	7	—	—	—	—	—	—	—	—	—	13
Lawreys *Cornish Giant* ..	8	12	—	9	—	12	—	12	—	—	—	—	—	15	—	—	18	—	—	—	—	—
*Lord Derby	10	17	—	—	15	—	12	—	—	—	17	—	—	—	21	—	—	—	19	—	—	—
*Lord Hindlip	9	15	12	—	—	—	—	—	—	17	—	—	19	—	—	—	—	21	—	—	15	—
*Margil	12	20	17	—	—	—	—	—	—	19	—	21	—	—	—	—	—	19	—	—	15	—
Mere de Menage	5	12	—	15	18	17	—	12	—	—	—	—	—	13	—	—	10	—	—	—	—	—
*Mr. Gladstone	10	18	—	—	—	—	—	—	17	—	—	20	—	—	—	—	—	—	—	—	—	16
*Newton Wonder	15	20	—	12	—	19	—	10	—	—	—	—	—	17	—	—	—	—	20	—	18	—
*Norfolk Beauty	9	13	—	—	—	12	—	—	—	—	—	—	—	—	15	—	13	—	12	—	—	—
*Peasgood's Nonsuch ..	10	17	—	13	—	12	—	10	—	—	—	15	—	—	—	—	16	—	15	—	—	—
*Pott's Seedling	12	15	—	—	—	—	12	—	—	—	16	—	—	—	19	—	—	—	—	—	—	—
Reinette du Canada	7	12	—	—	—	—	—	—	—	15	—	—	—	—	—	—	—	—	—	14	—	—
Ribston Pippin	3	9	—	—	—	—	—	—	—	17	—	—	—	—	—	15	—	—	—	17	—	—
*Rival	9	15	12	—	—	—	—	—	—	—	—	—	15	—	—	—	—	—	—	—	—	—
Rosemary Russet	6	9	—	—	—	—	—	—	—	12	—	—	—	—	—	—	—	15	—	—	—	—
*Royal Jubilee	12	17	—	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—
*Sandringham	10	17	—	—	15	—	—	—	—	—	—	—	—	12	—	—	19	—	17	—	—	—
*Scarlet Nonpareil	17	25	—	—	—	—	—	—	—	19	—	—	17	—	—	—	—	—	—	—	15	—
*St. Edmund's Pippin ..	13	15	—	—	—	—	—	—	—	12	—	—	—	—	—	16	—	19	—	—	12	—
*Stirling Castle	20	21	—	—	—	20	—	—	—	—	—	—	—	—	19	—	—	—	15	—	—	—
*Sturmer Pippin	10	18	—	—	—	—	—	—	—	22	—	—	15	—	—	—	—	17	—	—	—	—
*The Queen	12	15	—	—	—	23	—	15	—	—	—	—	—	17	—	—	12	—	—	15	12	—
Twenty Ounce	9	13	—	15	—	12	—	—	—	—	—	—	—	13	—	—	—	—	17	—	—	—
*Tyler's *Kernel*	12	17	—	—	—	—	—	15	—	—	—	—	—	—	—	—	—	—	12	15	—	—
Warner's King	9	16	—	—	—	15	—	—	—	—	—	—	—	—	17	—	—	—	13	—	—	—
*Washington	7	15	—	—	—	17	—	—	—	—	—	—	14	17	—	—	—	—	—	—	12	13
*Wealthy	12	18	—	—	—	20	—	10	—	—	—	—	17	—	—	—	—	—	15	12	—	15
White Transparent	5	12	—	—	—	—	—	—	15	—	15	20	—	—	—	—	—	—	—	—	—	—
*William Crump	10	12	15	—	—	—	—	—	—	—	—	17	—	—	—	—	—	—	—	—	—	18
*William's Favourite	12	15	—	—	—	—	—	—	17	—	—	—	—	—	—	—	—	—	—	—	—	15
*Worcester Pearmain ..	17	17	15	—	—	—	—	—	20	—	—	19	—	—	—	—	—	—	—	17	—	—
Yorkshire Beauty (syn. Red Hawthornden)	7	12	—	15	—	—	15	—	—	—	—	—	—	12	—	—	9	—	—	—	—	—
Average percentage ..	9·2	14·54	15·82	14·30	16·78	16·48	14·38	12·76	16·53	17·66	16·87	16·21	16·00	16·26	19·23	14·40	14·82	19·00	15·81	16·89	14·19	15·06

* Denotes free pollen bearers.

PEARS.

VARIETIES.	Own Pollen.	Mixed Pollen.	Bergamotte Esperen.	Beurré Clairgeau.	Beurré Hardy.	Beurré Rance.	Beurré Superfin.	Bon Chretien (Williams).	Conference.	Dr. Jules Guyot.	Emile d' Heyst.	Louise Bonne of Jersey.	Marie Louise d'Uccle.	Nouveau Poiteau.	President d'Osmonville.	Princess.	St. Luke.	Triomphe de Vienne.	Vicar of Winkfield.	Klondike (not in commerce).	Charles Ernest.
*Bergamotte Esperen	5	15	—	—	—	—	—	—	17	—	13	20	—	—	—	17	—	—	—	—	—
*Beurré d'Amanlis	7	20	—	—	—	—	—	15	—	17	—	—	—	—	—	—	—	22	—	24	—
Beurré Bachelier	5	17	15	—	—	—	—	—	—	—	—	—	16	20	—	—	—	—	12	—	—
Beurré Baltet Pere	9	18	—	—	—	20	—	—	—	—	15	—	—	17	—	—	—	—	—	—	13
Beurré Bosc..	3	12	—	—	15	—	17	—	—	—	—	—	15	—	—	10	—	—	—	12	—
*Beurré Clairgeau	12	19	—	—	—	—	—	—	20	—	17	—	—	15	—	—	—	—	16	—	—
*Beurré Diel	7	17	—	—	15	—	13	—	—	—	—	—	—	—	—	—	17	—	—	—	—
Beurré Dubuisson	5	13	—	—	—	12	—	—	—	—	—	—	15	—	17	—	—	—	—	—	20
Beurré Foqueray	12	17	—	—	20	—	—	—	15	—	—	17	—	—	—	15	—	—	—	—	—
*Beurré Hardy	12	22	17	—	—	—	20	—	17	—	—	—	—	—	—	—	—	—	—	—	25
*Beurré Mortillet	9	17	—	19	—	—	—	—	15	21	—	—	—	—	—	—	—	24	—	—	—
*Beurré Rance	15	21	18	—	—	—	—	—	—	—	—	—	—	—	23	—	—	—	—	—	21
*Beurré Superfin	12	15	—	—	17	—	—	—	19	—	—	16	—	—	—	—	20	—	—	—	—
*Bon Chretien (Williams)	12	18	—	—	—	—	—	—	—	23	—	—	—	—	—	—	20	—	—	17	—
*Charles Ernest	9	20	15	—	—	18	—	—	—	—	—	—	—	20	25	—	—	—	—	—	—
Chaumontel	5	12	—	—	—	15	—	—	—	—	—	—	17	19	—	—	—	—	—	—	15
Clapp's Favourite	3	15	—	—	16	—	—	15	—	—	—	19	—	—	—	—	—	21	—	—	—
*Conference	15	23	—	—	17	—	—	—	—	—	—	20	—	—	—	19	—	17	—	—	—
*Doyenné Boussoch	12	18	13	—	—	17	—	—	—	—	—	—	—	—	21	—	—	—	—	19	—
Doyenné du Comice	5	15	—	—	—	—	19	—	—	—	20	17	—	—	—	—	—	—	—	21	—
*Dr. Jules Guyot	15	22	—	—	—	—	—	17	—	—	—	19	—	—	—	—	—	23	—	15	—
Duchess d'Angouléme	7	10	—	—	—	—	15	—	17	—	—	—	—	—	12	—	—	—	—	—	—
*Durondeau	7	15	—	—	20	—	—	—	—	—	16	—	17	—	—	15	—	—	—	—	—

*Emile d'Heyst	15	25	17	—	13	—	18	—	—	—	—	20	—	—	—	—	—	—	—	—	—
General Todleben	5	12	—	17	—	—	—	—	—	—	—	—	—	20	20	—	—	—	18	—	—
*Glou Morceau	5	15	12	—	—	17	—	—	—	—	—	—	—	—	23	—	—	—	—	—	17
*Gratioli of Jersey	15	20	—	—	19	—	—	—	21	20	—	—	—	—	—	—	—	20	—	—	—
*Josephine de Malines	12	22	20	—	—	15	—	—	—	—	—	—	—	17	17	—	—	—	—	—	—
Le Lectier	3	12	—	—	—	13	—	—	—	—	—	—	—	12	15	—	—	—	—	—	19
*Louise Bonne of Jersey	15	21	—	—	—	—	—	—	19	—	17	—	—	—	—	23	—	—	—	20	—
*Madame Treyve	12	15	—	—	17	—	—	20	—	15	—	—	—	—	—	—	—	19	—	—	—
Magnate	2	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Marguerite Marillat	5	12	—	—	—	—	—	—	15	—	—	12	13	—	—	12	—	—	—	—	—
Marie Benoist	7	12	10	—	—	15	—	—	—	—	—	—	—	—	17	—	—	—	—	—	13
Marie Louise	3	12	—	—	—	—	—	—	—	—	—	15	17	—	—	—	—	—	13	—	17
*Marie Louise d'Uccle	9	17	—	—	15	—	—	—	18	—	—	20	—	—	—	—	—	—	—	17	—
*Nouveau Poiteau	9	19	15	—	—	20	—	—	—	—	—	—	—	—	19	—	—	—	13	—	—
Nouvelle Fulvie	7	15	20	—	—	12	—	—	—	—	—	—	—	17	—	—	—	—	—	—	10
Olivier de Serres	12	20	20	—	—	15	—	—	—	—	—	—	—	—	17	—	—	—	—	—	15
*Pitmaston Duchess	5	12	—	—	—	—	—	—	15	—	—	—	—	—	13	—	—	—	—	17	—
*President d'Osmonville	15	21	15	—	—	18	—	—	—	—	—	—	12	17	—	—	—	—	—	—	20
*Princess	15	25	—	—	—	—	—	—	20	17	—	21	—	—	—	—	—	17	—	—	—
St. Luke	9	17	—	—	17	—	—	12	—	—	—	—	—	—	—	—	—	—	—	15	—
*Souvenir du Congres	7	15	—	—	—	—	—	—	19	—	15	—	—	—	12	—	—	—	—	—	—
*Triomphe de Vienne	12	18	—	—	20	—	—	21	—	25	—	—	—	—	—	—	—	—	—	—	—
*Uvedale's St. Germain	5	12	—	—	—	15	—	—	—	—	—	—	—	—	13	—	—	—	—	—	17
*Vicar of Winkfield	7	13	—	15	—	—	—	—	17	—	—	—	12	—	—	—	—	—	—	10	—
*Klondike (not in commerce) ..	17	20	—	—	—	—	—	—	—	—	—	—	—	—	15	—	—	21	—	—	—
Average percentage ..	8·97	16·70	15·92	17·0	17·0	15.85	17·0	16·66	17·60	19·71	16·14	18·0	14·88	17·40	17·43	15·85	19·0	20·44	14·40	17·00	17·07

* Denotes free pollen bearers.

APRICOTS.

VARIETIES.	Own Pollen.	Mixed Pollen.	Kaisha.	Moorpark.	Oullins Early.
Hemskirk	15	20	28	25	30
*Kaisha	18	25	—	32	38
*Moorpark	20	35	30	—	42
New Large Early	17	25	23	25	25
**Oullins Early*	18	27	40	35	—
Shipley	19	23	33	27	32
*St. Ambroise	13	26	25	20	27
Average percentage..	17·14	25·85	29·83	27·33	32·33

* Denotes free pollen bearers.

NECTARINES.

VARIETIES.	Own Pollen.	Mixed Pollen	Cardinal.	Dryden.	Goldoni.	Pine Apple.	Spenser.
Byron	7	12	—	17	—	—	—
*Cardinal..	15	25	—	30	—	—	—
*Dryden	20	25	20	—	23	—	—
*Early Rivers	12	17	22	25	—	—	—
Elruge	12	15	—	20	17	—	18
*Goldoni	20	16	15	—	—	—	—
Humboldt	12	15	—	—	—	25	20
*Lord Napier	12	17	19	22	—	20	—
Newton	5	12	—	15	—	—	—
*Pine Apple	23	20	—	30	22	—	17
*River's Early *Orange* ..	17	25	15	—	27	20	—
*Spenser	12	18	—	—	20	25	—
Violette Hative ..	9	15	—	17	—	12	20
Average percentage ..	13·53	17·84	18·20	22·0	21·60	20·40	18·75

* Denotes free pollen bearers.

CHERRIES.

VARIETIES.	Own Pollen.	Mixed Pollen.	Frogmore Early Bigarreau.	Governor Wood.	Knight's Early Black.	Late Duke.	Morello.	Werder's Early Black.	Gean or Wild Cherry.
*Bigarreau de Schrecken ..	19	30	35	—	—	—	25	28	—
Bigarreau Napoleon	17	27	—	35	—	—	20	—	30
Black Tartarian	7	25	—	—	30	—	—	20	17
*Early Rivers	15	32	45	—	25	—	—	35	28
Elton	12	20	—	30	—	25	27	—	—
*Frogmore Early Bigarreau ..	28	45	—	—	40	—	—	30	—
*Governor Wood	19	25	27	—	—	—	20	—	30
*Knight's Early Black ..	23	38	30	—	—	—	—	25	28
*Late Duke	17	30	—	—	—	—	45	—	40
*May Duke	5	20	35	—	28	25	30	—	19
*Morello	45	40	—	—	—	30	—	—	42
Noble	9	25	20	28	—	—	17	—	15
Waterloo	12	28	15	—	25	—	20	—	20
*Werder's Early Black ..	25	42	—	—	30	—	—	—	25
Average percentage ..	18·07	30·50	29·57	31·00	29·66	26·66	25·50	27·00	26·72

VARIETIES.	Own Pollen.	Mixed Pollen.	Condor.	Crimson Galande.	Dr. Hogg.	Duke of York.	Dymond.	Early Grosse Mignonne.	Golden Eagle.	Late Devonian.	Peregrine.	Royal George.	Sea Eagle.	Thomas Rivers.
Alexandra Noblesse	9	15	—	21	20	—	—	—	25	—	23	17	—	—
Barrington	12	20	—	—	—	—	—	—	22	20	30	—	23	25
*Bellegarde	17	18	—	—	—	—	20	—	—	—	25	23	—	—
*Condor	15	20	—	25	23	30	—	21	—	—	—	—	—	—
*Crimson Galande	20	20	—	—	22	—	—	24	—	—	28	25	—	—
*Dr. Hogg	25	27	—	—	—	23	—	27	—	—	22	—	—	—
*Duchess of Cornwall	20	21	18	—	21	25	—	—	—	—	—	—	—	—
*Duke of York	20	25	—	—	20	—	—	17	—	—	27	21	—	—
*Dymond	17	21	—	23	—	—	—	—	—	—	21	27	—	—
Early Alexander	9	22	17	—	22	27	—	19	—	—	—	—	—	—
*Early Grosse Mignonne	15	17	—	27	23	20	—	—	—	—	—	—	—	—
Early Louise	12	15	20	—	—	17	—	15	—	—	—	—	—	—
Early Silver	10	12	17	—	21	23	—	18	—	—	—	—	—	—
Exquisite	10	20	—	25	—	—	17	—	—	—	19	20	—	—
*Golden Eagle	25	21	—	—	—	—	—	—	—	22	—	—	23	30
Goshawk	17	16	—	23	—	—	25	—	—	—	30	—	—	—
Grosse Mignonne	12	15	—	17	—	—	20	—	—	—	21	19	—	—
Hale's Early	7	10	17	—	23	27	—	—	—	—	—	—	—	—
Late Admirable	7	13	—	—	—	—	—	—	20	—	—	—	21	23
*Late Devonian	15	20	—	—	—	—	—	—	25	—	—	—	20	20
Nectarine Peach	15	17	—	—	—	—	20	—	22	19	—	—	21	20
Noblesse	12	20	—	25	—	—	18	—	—	—	22	20	—	—
*Peregrine	25	20	—	23	—	—	21	—	—	—	—	21	—	—
Princess of Wales	12	19	—	—	—	—	—	—	23	—	—	—	19	23
*Royal George	20	21	—	20	—	—	23	—	—	—	23	—	—	—
Rivers' Early York	15	20	17	—	25	21	—	20	—	—	—	—	—	—
*Sea Eagle	20	23	—	—	—	—	—	—	21	20	—	—	—	25
*Thomas Rivers	25	20	—	—	—	—	—	—	20	19	—	—	22	—
*Violette Hâtive	17	25	—	22	—	—	24	—	—	—	20	25	—	—
Walburton Admirable	9	15	—	—	—	—	—	—	20	17	—	—	20	19
Waterloo	12	13	20	—	17	21	—	—	—	—	—	—	—	—
[Average percentage ..	15·35	18·74	18·0	22·81	21·54	23·40	20·88	20·12	22·0	19·50	23·02	21·80	21·12	23·12

* Denotes free pollen bearers.

PLUMS.

VARIETIES.	Own Pollen.	Mixed Pollen.	Blue Rock.	Count Althan's Gage.	Denniston's Superb.	Early Prolific.	Grand Duke.	Heron.	Jefferson.	Late Orange.	Mallard.	Monarch.	Oullins Golden Gage.	Pond's Seedling.	Prince of Wales.	Swan.	Curlew.	Cox's Emperor.	Coe's Golden Drop.
Admiral	12	15	17	—	—	—	15	—	—	—	—	17	—	—	—	—	15	—	—
*Angelina Burdett	15	17	—	15	20	—	—	—	—	—	17	—	—	—	15	—	—	—	—
Belle de Louvain	12	17	—	—	—	—	—	15	—	—	—	—	10	—	—	20	—	13	—
*Belle de Septembre	10	15	—	12	—	—	17	—	—	—	—	—	—	19	—	—	—	—	—
*Blue Rock	25	21	—	—	17	15	—	20	—	—	15	—	—	—	—	17	—	—	—
Bryanston Gage	3	12	—	—	20	—	—	—	17	12	—	—	15	—	—	—	—	—	10
*Coe's Golden Drop	10	17	—	—	15	—	17	—	15	20	—	—	15	—	—	—	—	—	—
*Count Althan's Gage	12	20	23	—	—	—	—	17	—	—	17	—	—	15	—	—	—	17	—
*Cox's Emperor	12	16	—	—	—	—	12	—	15	—	15	—	—	—	20	—	15	—	—
*Curlew	15	22	24	15	—	—	—	20	—	—	—	15	—	—	—	25	—	—	—
*Czar, The	15	25	23	—	—	17	—	19	—	—	17	—	—	—	—	—	21	—	—
*Denniston's Superb	25	27	21	—	—	—	—	—	20	—	—	—	17	—	—	—	—	—	19
Diamond	9	15	—	—	—	—	21	—	—	—	—	17	—	—	—	23	18	—	—
Early Prolific	5	12	17	—	15	—	—	13	—	—	—	—	—	—	—	—	12	—	—
Early Transparent Gage	5	12	—	—	17	—	—	—	20	15	—	—	18	—	—	—	—	—	15
Golden Esperin	3	7	—	—	12	—	—	—	14	—	—	—	10	—	—	—	—	—	12
Golden Transparent Gage	3	7	—	—	9	—	—	—	10	—	—	—	12	—	—	—	—	—	10
*Grand Duke	12	17	—	15	—	—	—	—	—	—	15	20	—	—	—	18	—	—	—
Green Gage	3	10	—	—	12	—	—	—	10	15	—	—	12	—	—	—	—	—	10
*Heron	15	19	20	17	—	—	—	—	—	—	15	—	—	12	—	—	15	—	—
*Jefferson	12	20	—	15	25	—	—	—	—	19	—	—	23	—	—	—	—	—	17
July Green Gage	12	17	—	—	20	—	—	—	15	—	—	—	17	—	—	—	—	—	12
Kirk's	10	15	—	17	—	—	17	—	—	—	—	20	—	—	12	—	—	—	—

*Late Orange	17	23	—	—	20	—	15	—	17	—	—	17	—	20	—	—	—	—	20
Late Transparent Gage	1	7	—	—	5	—	—	—	3	7	—	—	—	—	—	—	—	—	5
*Magnum Bonum, White	12	19	—	—	15	—	—	—	13	17	—	—	12	15	—	—	—	—	10
*Mallard	17	21	18	15	—	—	—	—	—	—	—	20	—	17	—	20	—	—	—
McLaughlin's Gage	5	12	—	—	17	—	—	15	12	—	—	—	15	—	—	—	—	—	—
*Monarch	15	23	—	19	—	—	20	—	—	—	17	—	—	12	—	13	—	—	—
Orleans, New	13	17	15	17	—	—	—	20	—	—	15	—	—	—	13	—	—	17	—
*Oullins Golden Gage	15	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
*Pond's Seedling	15	20	—	19	—	—	13	—	19	—	13	—	—	—	—	—	—	15	—
President	7	10	—	12	—	—	15	—	—	—	—	12	—	—	—	—	—	—	—
Primate	3	7	—	7	—	—	5	—	—	10	—	—	—	—	—	—	—	—	—
*Prince of Wales	12	17	15	—	—	—	—	15	—	—	19	13	—	—	—	—	—	—	—
Reine Claude de Bavay	7	15	—	—	15	—	—	—	12	—	—	—	10	—	—	—	—	—	—
*Sultan	15	19	17	—	—	10	—	20	—	—	17	—	—	—	—	—	15	—	—
*Swan	27	25	15	—	—	—	—	19	—	—	23	—	—	—	—	—	20	—	—
Transparent Gage	3	10	—	—	10	—	—	—	7	9	—	—	10	—	—	—	—	—	10
*Washington	5	13	—	—	15	—	—	—	12	12	—	—	—	—	—	—	—	—	15
Average percentage ..	11·10	16·39	18·75	15·0	15·5	14·0	15·2	17·64	13·53	13·60	16·53	16·77	14·0	15·71	15·0	19·43	16·37	15·5	13·15

* Denotes free pollen bearers.

KARAKUL SHEEP.

ROBERT WALLACE.
Professor of Agriculture and Rural Economy, University of Edinburgh.

THE Karakul sheep are the best fur-producing breeds of the lofty plateaux of Central Asia. Their home is in the arid region in Western Russian Turkestan comprising the Kizil-Kum and Kara-Kum deserts and the Khanates of Bokhara and Khiva. The district is situated east of the Caspian Sea and north of Afghanistan. Northern Afghanistan also has a few Karakul sheep, and a few are raised in Persia. The name Karakul (meaning "black lake") refers to the lake in the town of the same name on the lower Zarafshan in Bokhara, which is an important centre of the lamb-fur and sheep-skin

1.—Kara-Kum Desert showing the Bushes of Sacksaul on which Karakul Sheep and Camels feed.

industry. The Kara-Kum Desert (Fig. 1) is extremely barren, consisting of sand dunes and saline steppes covered with thorny scrub, and, where there is no drifting sand and the soil is clayey in nature, a little grass in spring. During the summer it is very hot and there is little rain, while in winter the temperature falls below zero. Under such trying climatic extremes it is little wonder that the Karakul sheep have earned the reputation of being perhaps the hardiest of all domesticated animals.

Origin of the Breed.—There is no subject in which there is more confusion with regard to facts in general, including classification, than that of Asiatic sheep. Towards this state

of uncertainty there are several contributory causes. Military considerations forbid exploration in Afghanistan and in important regions of Bokhara under Russian domination. Moreover, neither the ancient nor the modern authorities have properly differentiated between the two great branches of the ovine race which supply the preponderating numbers of the vast hordes of sheep of Western Asia—the fat-rump or "Kurdiuk" type (*Ovis steatopyga*), and the broad-tail type (*Ovis platyura*). The Karakul breeds are correctly classified as a type of the true *Ovis platyura*, having sprung from a cross of the black, long-tail Danadar, now practically extinct on the fat-rump varieties known as Chulmi and Achuri.*

FIG. 2.—Types of Karakul and other Asiatic Sheep.

eft to right:—(1) Shorn red Kalmuck fat-rump ram; (2) Shorn Karakul ram; (3) Unsh 4-horned Karachaev ram; (4) Karakul-Afghan Fine-wool ewe (of no value as a producer), and, behind, a Karakul Coarse-wool ram; (5) Karakul lamb, 3 months (the curls having opened and the fur value being lost.

Karakul sheep are invariably classed under three orders, Arabi, Duzbai and Shiraz. (1) The first order seems to indicate that this breed was first introduced from Arabia, although neither history nor the Arabian sheep of to-day support the assumption. (2) The Karakul sheep of the Duzbai order, which, like all Asiatic sheep, is not an absolutely pure breed, has produced the best fur since the disappearance of the historical Small Arabi.† (3) In Bokhara and across the

* Various American breeders, including Dr. C. C. Young, have produced broad-tailed sheep by crossing long-tails on fat-rumps.

† Dr. Young states that this was practically the original black Danadar.

mountains in Persia one finds the "Shiraz" or half Persian sheep, named from the town of Shiraz. Any grey lamb is now called a Shiraz. Their quality depends on whether a good or a bad Karakul ram had been got from Bokhara and whether he had been bred to coarse-wool, fat-rump or soft-wool Afghan ewes. Figs. 2 to 5 show types of Karakul and other Asiatic breeds of sheep.

Characteristics.—The Karakul-Duzbai is a large sheep, altogether black at birth, with the possible occasional exception of a white spot on the forehead or a white tip to the tail. As a rule the ewe is hornless, and the ram generally, though not invariably, carries horns of moderate dimensions which fall short of making a spiral turn. The head is long, somewhat narrow, with a high, arching nose descending abruptly to the muzzle and giving it something of a tapering appearance, partly the result of the shape of the nostrils, the lips of which are folded in and contracted rather than expanded, evidently as a natural protection against driving sand. The ears are of medium length and pendant, as is the rule with the ears of most domestic animals of the tropical East. The bone is strong and clean, the legs tight and well formed and the feet large. The movement in walking or running is free and active, and the carriage gay. The withers are high and sharp, the loins broad and the hind quarters low, short and markedly drooping. The characteristic tail "tapers into a noticeably twisted end," the broad, flat, fatty base sometimes weighing as much as 15 to 20 lb. in full-grown rams. The store of nutriment in the tail is akin to the reserve provided by the hump of the camel and of the zebu race of cattle, and, being drawn upon for sustenance in cases of emergency, it enables an animal deprived of food and water—no unusual occurrence in the desert—to subsist for many days. The characteristics of a Karakul-Duzbai may be seen in Figs. 7 and 8 (pages 440 and 441).

When the Karakul-Duzbai is crossed with European sheep there is a wonderful increase in weight, owing to the preponderance of the fat-tail blood. Karakul mutton is of excellent gamey quality, free from the sheepy flavour that is specially characteristic of a full-grown Cotswold, and, to a less degree, of many other essentially fleshy longwool British breeds. The manager of the Armour Packing Company, of Fortworth, Texas, has written of Karakul crosses with other domestic breeds of sheep: "Lambs are obtained which at the proper lamb age weigh 90 to 105 lb. and have a most delicious flavour, as well as a heavy yield of mutton."

FIG. 3.—Afghan Fine-wool Sheep in the Afghan Border Region.

FIG 4.—*Left* : Shiraz Ram ; *Right* : Duzbai Ram.
Both purchased near Kara-Kum, Bokhara, and sent to Prince Edward Island.

Karakul ewes sometimes breed twice in the year, but, except when placed under exceptionally favourable circumstances, this is a severe strain on any breed of sheep, and is not general. Some produce twins and triplets. The lamb has for about three days a close lustrous fur (Fig. 12), which afterwards becomes loose and open and grows rapidly in length. At about the third month, as a rule, a fleece, still quite black, of straight wool has developed in the ram, but it begins to turn grey about the sixth month. The hair-like wool becomes long and strong, although it still retains much of its lustre. The similar wool of ewes, when of highest quality, retains for a longer period a remnant of the early curly condition in loose and open locks. It is important to note that for fur-producing purposes the Karakul-Duzbai ram alone produces a useful cross, and that lambs resulting from crossing a Karakul ewe and a ram of another breed are inferior.

Production of Fur.—The most essential feature of the wool of the Karakul sheep as it ought to be is the complete absence of the undercoat of fine, downy wool belonging the Afghan fine-wool sheep. The jet-black, tight-curling, lustrous fur of the newly-born lambs is the most important characteristic of the breed, and, with one exception, is the most valuable commercial product. This fur is misleadingly called "Persian Lamb" in the trade, and though two explanations are put forward, it is not definitely known how the mistake arose. The correct name, from a geographical point of view, would be "Bokharans," as none of the lamb-skins came from Persia until about twelve or fifteen years ago, when a few of very inferior quality appeared.

The value of the "Persian Lamb" skin depends (1) on the form and tightness of the long, pipe-shaped curl, the points of the closely-knit locks in the finest specimens being turned in so that few ends appear on the surface; (2) on the beauty of the pattern formed by the irregular yet artistic arrangement which, along each side of the back line, often takes the form of delightful natural unrestrained bars, and (3) on the thinness or fineness and softness of the hair or wool, together with its great brilliancy. Fig. 12 shows an exceptionally fine "Persian Lamb" fur, while Karakul and cross-bred lambs possessing skins of various qualities may be seen in Figs. 6, 9, 10 and 11.

"Persian Lamb" skins have a length of about 20 in., and come to the market in an air-dried, raw condition, the value of first-grade skins being about £1 10s. each, imperfectly curled skins being very much less, down to a few shillings or

even pence. The best skins are produced by lambs killed within 75 to 80 hours after birth ; the small size then to some extent counterbalances the money value of the superior quality and tightness of the curl.

Although the skins can easily be separated into a few lots according to their market value, the individual variation is so great that out of hundreds, or even thousands, it is practically impossible to find two skins that exactly match. There are broadly three divisions according to the size of the curl—small, intermediate and large. In Russia the intermediate curl is most prized, other factors being equal. Considerable variation in the size of the curl appears in different offspring from the same parents, and by some this has been attributed to feeding, though, like the colour and quality of the hair of some of our domestic animals in this country, it is probably due to natural constitutional variation.

The low average price of a large quantity of skins shows that an enormous number of inferior sheep are kept which ought to be capable of improvement by scientific breeding. In 1905 one Leipzig house bought in Bokhara 385,000 skins at 16s. each. Dr. C. C. Young, of Belen, Texas, who is an authority on Karakul sheep, and who has several times visited Bokhara, asserts that the quality has declined 85 per cent. in 10 years.

The so-called "Broadtail" fur, which presents a fine, short, straight, figured, velvet-like hair of glossy black and great lustre, preserved by careful dyeing, with a beautifully figured water-mark through it, is identical with the curly "Persian Lamb" fur derived from a good Karakul-Duzbai, but is obtained at an earlier stage of development. The pelts are in consequence scarcely half as large, although often more costly, ranging in price from £1 10s. to £3 each. The skins are those of prematurely born lambs thrown by the ewes that suffer from a disease known as "djut," and although brought into the world alive the lambs generally are so frail and weak that they would certainly die within a few hours. It is necessary to kill, bleed and skin them as quickly as possible to preserve the quality of the fur and the wearing power of the skin when cured, as well as to prevent injury to the skin when pulling it off, which might easily reduce its value by 50 to 75 per cent. At the best the skins of "slinks," although often very beautiful, are fragile and have little wearing power, being liable to crack during use. Even the best "Broadtail" skins, although much more costly, fall far short of the durability and wearing quality of "Persian Lamb" skins.

FIG. 5.—The Cream of some sixty Head of Karakul sheep selected by Dr Young: twenty-one of them went to Prince Edward Island.

FIG. 6.—Karakul Ewe and Lamb in Prince Edward Island.

There are three ways of preserving lamb-skins in preparation for transit: (1) drying them, by toggling without stretching when quite green in a shady place away from the direct influence of the sun; (2) salting them and placing them for a night in heaps of pairs with the green sides put together, the surplus salt being shaken out in the morning and the skins being exposed to dry; and (3) in Bokhara, pickling them in coarse barley flour by a patent process in high favour with certain pickling firms, who guard their secret carefully.

In Asia "Persian Lamb" skins are never dyed, and those most directly descended from the fountain head of blackness retain their colour without fading into brown when exposed to the sun as the black wools of English and Australian sheep are liable to do. In Europe and America all black lamb-skins are dyed black to make certain that the colour will not fade, and also to intensify the natural lustre. No mode of dyeing will, however, give lustre to a wool which is not by nature lustrous. It is this remarkable quality of lustre which has brought lamb-fur into fashion and is the infallible guarantee that public appreciation is of a permanent kind.

Skins with tight grey curls are very rare and bring from £2 2*s*. to £5 5*s*. each; they are classed as Shiraz. Grey Crimean ("Krimmer") skins are used in Russia for the requirements of the private soldier, and in other parts of the world for ordinary fur purposes. The curly locks are somewhat large and more open than those of "Persian Lamb," although there is great variation in this particular, due to the amount of fine-wool blood present in the producing sheep. The wool of Grey Crimean sheep is uniformly grey and its origin can only be conjectured. The sheep have been in the Crimea for half a century and are supposed to have come from Bokhara *via* the Caucasus.

Not infrequently may be seen Karakul fur in which grey hair is intermixed. Local fur dealers call it grey "Shiraz." Grey lamb-skins when dyed do not develop the lustre or take the dye so satisfactorily as black skins of similar quality, though the dark brown skins do.

The origin of the dark pigment in Karakuls and other strains of Asiatic sheep is believed to have been the Black Danadar which is now practically extinct in Bokhara, though a few grey Danadars still exist near Kedjumek. The Black Danadar always remains black from youth to age, not becoming grey as do the Arabi and Karakul-Duzbai. The Black Danadar, the "Look Nakbo" of Tibet, according to

Young, is a small sheep, with a small head, small erect ears, small thin feet and a long tail reaching to below the hocks. *Its wool is very lustrous, strong, though not coarse*, and wavy in the adult, the wool being shorter than that of the English long-wool. The curls of new-born lambs are very fine in texture, but are not specially tight.

The Karakul Sheep Industry in Bokhara.—The Karakul sheep industry centres in the foothills of the mountains that form the southern boundary of Bokhara, the cultivable land in the valleys being utilised for gardens and orchards. The flocks are driven in autumn, when the first snow falls, from

FIG. 7.—Karakul-Duzbai Ram at the Farm of the Edinburgh and East of Scotland College of Agriculture.

their summer quarters on the higher plateaux into the "Kishlaks" of the valleys. They are kept there until the lambing season is past, and in early spring they are driven back to the higher desert grazings which are unsuited to cultivation. The sheep are kept always in the open, and during winter are more or less protected from the cold winds in the hollows of the mountains and live mostly on dry stalks kept clear of snow by the wind.

To give the lambs a good start in life, the lambing season is regulated to come when there is an abundance of plants and flowers to develop the plentiful supply of milk that the ewes are capable of yielding. The time of lambing is determined

by tying an old rag round the belly of the rams to form a screen, which renders him incapable for the time being. In Bokhara the lambing season extends from January to May, with the busiest period in March and April. One ram unattended may not suffice for more than 30 to 50 ewes during the season on account of the difficulty presented by the ewes' fat tails, but, when rams are properly looked after, coupling becomes more certain and one ram may settle 70 females.* A ram can remain in service for from 8 to 12 years, and ewes live from 7 to 10 years. The liberal supply of mother's milk

FIG. 8.—Head of the Ram shown in Fig. 7.

in youth and the abundance of "saline bitter pastures" combine to develop in the Karakul-Duzbai a big sheep, the ewes often weighing 200 lb. and the rams over 300 lb.

After midsummer, the lambs kept for breeding are weaned. The ewes continue to give a considerable quantity of rich, delicious milk till late in the autumn. The famous "Brinza" cheese, which is greatly esteemed in southern Asiatic Russia, is made from it to the amount of 30 lb. to 40 lb. from each

* George Rounnel, of the U.S.A. Department of Agriculture, puts the number at 123 ewes under a system of hand breeding.

ewe. "The people of Bokhara claim that the milk from Karakul sheep is the richest and most nourishing obtained from any living animal."

Good fur-producing Karakuls are found only in very limited numbers and on certain ranches owned by Bokhara noblemen, who, however, do not even make an attempt to prevent in-breeding or to secure the elimination from the breeding stock of Afghan blood, which is indicated by the fine, downy wool underneath the hairy fleeces. The result is that good sheep and good lamb furs are steadily decreasing in numbers and are believed to be within measurable distance of extinction. The limit of production has long ago been reached in Bokhara. The figures showing the quantities of skins collected there annually vary somewhat round about 1,500,000 "Persian Lambs" and 100,000 "Broadtails." The actual figures for 1911 and 1912 are as follows:—

"Persian Lamb" skins collected in			1911	..	1,500,000
,,	,,	,,	1912	..	1,814,000
"Broad-tail"	,,	,,	1911	..	100,000
,,	,,	,,	1912	..	35,000

The increase of 314,000 "Persian Lambs" and the decrease of two-thirds of the usual number of "Broad-tails" collected in 1912 were due to favourable climatic influence. The average annual value of this export trade has been estimated at approximately £1,000,000.

Colonisation of the Karakul Breed.—It was at one time asserted that only on the steppes of Asia would the Karakul sheep retain the curly character of its coat, and that on land where the ewes wander outside the natural districts the characteristics were gradually lost with the second, third and fourth lambs; and it was, therefore, considered doubtful if the valuable qualities of the fur could be maintained in the case of lambs bred in Europe and America. This opinion was probably the result of imperfect observation, as Asia contains many sheep which do not possess the characteristics peculiar to the Karakul, and which may have provided the sires of later lambs.

There are instances on record of more or less successful breeding of Karakul sheep for their lamb-fur in all the great continents. About 16 years ago the first flock of Karakuls was imported into the Crimea, and they have done well.

In 1902 Councillor Paul Thorer, the senior partner of Theodore Thorer, one of the largest and oldest established of the fur merchants of Leipzig, became interested in the possible

FIG. 9.—Cheviot Ewe and her Karakul Cross Lamb, showing a very poor Type of Fur.

FIG. 10.—Blackface Ewe and her Karakul Cross Twin Lambs, 3 days old.

advantage of the propagation of Karakul sheep in German colonies. He enlisted the sympathy of the King of Saxony, and the idea was taken up by the Director of the Agricultural Institute at Halle. In 1903, 4 rams and 26 ewes of what were believed to be pure Karakuls were secured from Bokhara and were established on a farm at Lindchen, in the Mark of Brandenburg, while two years later another small lot was obtained. Experiments proved that "at least no deterioration in quality could be shown to exist in the lambs born of the original imported sheep." Some German landowners subsequently made an attempt to breed Karakuls for fur, but the high cost of feeding is a serious drawback to development. It is, moreover, to be feared that the sheep imported had not been selected with a view to the complete exclusion of fine wool, for Dr. Young reported in 1912 that he "examined 60 ewes descending from Thorer's flock and only found three of them void of the fatal down-like underwool." Karakul sheep were also introduced to the sandy districts of the northern plains with the intention of increasing the value of the poorer parts of Germany. The Rhoen sheep gave the best results, but not till the seventh top-cross of pure Karakul ram.

In order to introduce the sheep to the Trans-Caspian districts the Russian Department of Agriculture established some 13 years ago a State sheep farm, picked ewes and rams being brought from Bokhara. The wrong type of sheep seems to have been procured, as Dr. Young after examining some 1,500 so-called Karakuls on this station reports that he "did not find one fur-producing sheep" (he meant, of course, of good Karakul quality and free from fine wool), "all being Arabi-Afghans." A number of stud rams and ewes are, nevertheless, sold annually to the inhabitants of the surrounding country, as well as to other breeders.

Karakul sheep have been drafted into the Kuban district, towards the north-west of the Russian province of the Caucasus, bordering on the Sea of Azov. Where these have been crossed with local breeds, soft-wool sheep must have been more or less rigidly rejected. Dr. Young reports that each ewe produces one or two lambs, the skins of which fetch from 1 to 2 guineas, and, in the case of good skins, 3 guineas. According to the Poltava Agricultural Society's prices, ordinary breeding Karakul sheep sell at from 6 to 8 guineas, but those known to give specially good results cost from five to ten times as much.

Dr. Young throws valuable light on the position of the trade in the distribution of rams, and of their prices and quality,

in a report on the sale of 90 Karakul rams among other Asiatic sheep which took place at Moscow in October, 1912. Many were sold at 8 to 30 guineas and even 60 guineas each, although the best tight-curl producers were few. In the great majority of cases there was evidence of a strain of the white fine-woolled Afghan, a type of wool that seriously injures the formation and the tightness of the curl as well as its lustre. The impurity of blood was indicated by the soft wool on the head, neck, abdomen and body, and even on the lower extremities of the limbs, which in the true fur-producing sheep are always covered with very lustrous, jet-black, stiff hair, similar to the hair of the face and ears. There were only about 10 of the best fur-producing sheep in the consignment.

The most extensive venture in introducing Karakul sheep to a distant country was made in January, 1909, when 252 ewes and 22 rams were shipped to German South-West Africa from Bokhara. Within a few months of landing the greater part of them were reported to have succumbed to blue-tongue and catarrhal fever. Of the few that were saved the lambs did well, and it is now understood that the industry is an established success and that the sheep have found climatic conditions on the higher plateaux of German Damara Land and Namaqua Land which are not far removed in certain particulars from those of their original habitat.

Perhaps the most remarkable, if not the largest, colonisation of the Karakul breed was effected in Texas by Dr. Young. In 1908 he introduced 15 pure-bred Karakuls, about 8 guineas per head being paid for 10 ewes and 10 guineas each for 5 rams; only one ram, however, bred true to type and produced good skins. The estimated cost, with travelling and other expenses included, was not far short of 200 guineas per head before they finally reached their destination. The time occupied was 14 months and included 9 months' quarantine, first in Russia and finally at the Federal quarantine station in New Jersey to avoid the dreaded danger of introducing surra, or some other little understood Asiatic disease. No trace of any disease was found, nor was it likely to be in sheep from such a healthy country as Bokhara, where surra does not exist. The wonderful hardiness of the breed, as compared with other large long-wool breeds, was demonstrated by the fact that through the trying ordeal of the long and tedious journey, including incarceration for over 3 months in a dark barn, none of the original animals, nor any of the 7 lambs

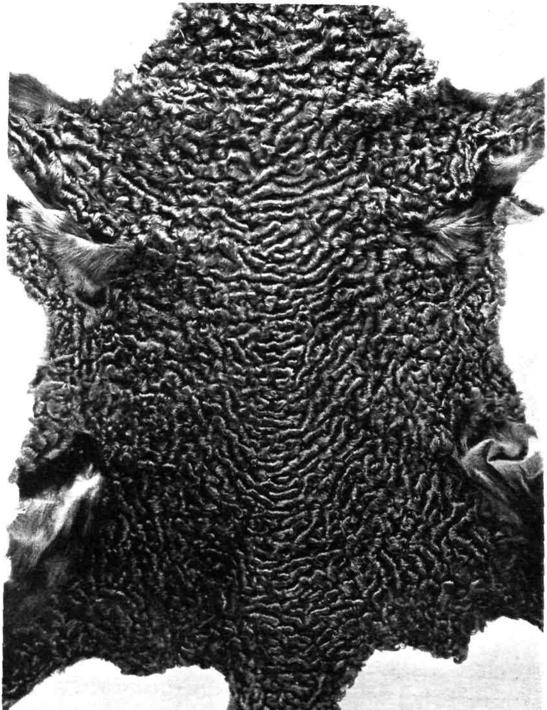


FIG. 12.—A "Persian Lamb" Fur of exceptionally fine quality, taken under 3 days ol
The photograph was lent by Mr. Ernest Poland.

born at New Jersey, making a total of 22, died on the way. Darkness was believed to be necessary to test for the presence of surra.

Until comparatively recent years it was practically impossible to get any Karakul sheep out of the country, and, even now "the Authorities of Bokhara put every obstacle in the way of foreigners attempting to export the valuable animals." To make the position still more difficult, the Emir has recently issued an edict absolutely forbidding the exportation of Karakul sheep, and none are supposed to have left the country since, except those obtained by the various agricultural societies of European Russia.

Owing to these difficulties and the fact that the Bokharan traders will, if possible, provide Karakul-like cross-bred animals in place of the pure-bred sheep that would breed trne, it is an extremely uncertain undertaking to secure the genuine Karakul sheep, even for those willing to pay a good price. Dr. Young got his sheep by means of letters of introduction to the Russian Government from ex-President Roosevelt and Secretary Root, but only with the greatest difficulty.

In 1911 Dr. Young's flock had increased to 56 in number, and eventually a Karakul Sheep Company was formed to take them over. Pure-bred Karakul rams were bred to a number of high-grade long-wools, including Lincolns and Cotswolds as well as close-woolled Merinos and Downs. The long-wool results proved so satisfactory, and especially the Lincoln cross, that 1,000 high-grade Lincoln ewes were secured and bred to Karakul rams in 1912.

A second importation, consisting of 11 rams and 6 ewes arrived in quarantine at Baltimore in March, 1913; one valuable ram died in quarantine, which left rams of only 7 unrelated high-class blood lines in America. Five of the rams were bred to 400 Lincoln, Highland, Blackface, Leicester, and other long-wool ewes, including a few Karakul ewes, but the result of these tests has not been made public.*

The United States Bureau of Animal Industry conducted experiments by crossing a selected Karakul ram with ewes of the Barbado breed (a cross from the Barbary). The Barbado second cross was entirely satisfactory, and a beautifully smooth, figured, rich, velvet-black skin was produced. Dr.

* Since the foregoing was written Dr. Young succeeded in getting out in the end of July, 1914, another specially selected lot of about the same number as the first lot of sheep exported, in spite of the existing embargo upon foreigners entering the military zone of Bokhara. They left Libau by the last steamer for New York before the outbreak of the war, but six rams were lost through an outbreak of fire in the quarantine station in the spring

Young obtained excellent results from breeding Karakul rams to high-grade, fawn-coloured Persian fat-rump ewes that were imported into the United States a little earlier than his own sheep, and were free from fine wool.

The Young Karakul Sheep Co., Ltd., Charlottetown, P.E.I., Canada, has had some promising results by breeding with Scotch Blackface ewes, but the humid climate is a hindrance to progress.

Experiments in Scotland.—An interesting experiment was initiated under the auspices of the Edinburgh and East of Scotland College of Agriculture and the Board of Agriculture for Scotland, when a Karakul-Duzbai ram was bought for £100 in the autumn of 1913 through Dr. Young from what he pronounced to be the best flock of fur-producing Karakuls in European Russia. In characteristic breed points the ram conformed closely to what is looked for in a Karakul ram of high breeding, with the exception that he had scurs in place of horns and that slight traces of fine under-wool were to be found, especially near the root of the tail and about the ears. He was mated, though a little late in the season, to 37 selected pure-bred ewes belonging to the following British breeds :—Scotch Blackface, Border Leicester, Romney Marsh, Herdwick, Cotswold, Dartmoor and Cheviot. The tup worked well and got 40 lambs—all without exception black and curly, though the curls differed in degree of tightness. The lambs showed pronounced Karakul characteristics, including, with one exception, drooping ears and a rudimentary fatty enlargement near the base of a long tail. In two cases only the tail had a white tip, which was correlated with a white spot on the forehead.*

The lustrous, tightly-curled fur, which the best of Dr. Young's rams produced in the first generation, did not appear ; but the ewe lambs, with a single exception, have been kept.† Within four or five generations of sheep it should be possible to produce a high-grade Karakul-Duzbai even superior to the original pure breed, and to develop rams, made " pure by crossing " by the use of pure-bred sires, that would breed true to type and be of even higher quality and of greater value than the sheep which can be bought in the market at present.

* A report on the considerably extended trials of 1914-15 is not yet available.

† It was intended to breed them to a pure-bred Karakul buck in the autumn of 1914, but the expected ram was detained at Libau on the outbreak of war, and he died of a disease said to have been induced by close proximity to the sea.

Conclusion.—Unqualified success in fur breeding, although now believed to be certain, is coming more slowly than might have been anticipated. The prospects of establishing a new meat industry in this country are, however, most encouraging. The carcasses of the ram lambs, which weigh from 8 lb. to 10 lb. each when 75 to 80 hours old, have proved to be a rare delicacy, which would doubtless soon become appreciated. There is no reason why Karakul "baby lamb" should not be received with the favour attending "baby beef," and command the remunerative price of 3*s.* per lb., thus providing a solid basis on which a British Karakul lamb-fur industry might be reared.

The interest of the scientific world is so new in connection with this industry, and there is such a wide gap between the fur breeder in Asia and the fur merchant and fur wearer in Europe and America, that much uncertainty prevails as to the origin and history of the best fur-bearing sheep and the most successful way to conserve and develop them. Opinions are only now being formed and reliable information is slowly taking the place of what was mere conjecture or romance. The subject is not only of value from the scientific point of view, but there is great scope for the development of its commercial as well as its æsthetic aspects, and there are sufficient guarantees that the business of sheep-fur production, now in its infancy, is likely to expand to almost indefinite proportions.

The writer wishes to acknowledge his indebtedness to Dr. C. C. Young, Mr. Ernest Poland, and the Edinburgh and East of Scotland College of Agriculture for kind permission to reproduce the photographs illustrating this article.

Fruit Preserving for Small Market Growers or for Domestic Use.

ALTHOUGH the fruit crop this year is not likely to be so large as it was in 1914, the need for avoiding waste and for making full use of all garden produce is perhaps greater, and, in view of the appeals that are being made to economise in food supplies obtained from abroad, everything possible should be done to conserve the supplies grown at home.

One of the most important methods is the preservation of fruit, and small growers and householders should take the greatest pains to ensure that the whole of their produce is utilised. If threatened with any disease it should be gathered as soon as it is possible to put it to any profitable use. Even slightly diseased fruit

can, if properly treated, be made acceptable for home consumption, though it should not be sold. Fruit can be (1) made into jam, (2) bottled, or (3) dried.

1. *Jam-making.*—The methods for making jams at home are generally known and widely practised in England, and no detailed instructions are necessary. Owing to the scarcity of sugar, which is entirely imported, householders are recommended to make use of glucose, which is very largely manufactured in England. Good results may be obtained by using one part of glucose to two of sugar. Glucose can be obtained in large quantities from the manufacturers, or in small quantities from confectioners.

2. *Fruit-bottling.*—The best method of preserving fruit without the use of sugar, glucose, or any other added preservative, is to sterilise the fruit in bottles.

Vacuum Process.—A proper sterilising apparatus, including a dozen bottles, could be bought before the war for about 14*s.*, but as the price of glass bottles has increased recently, a similar outfit will now be rather dearer. The bottles are constructed so that they can be hermetically sealed with either glass or tin caps, and alone formerly cost about 3*s.* 6*d.* to 4*s.* a dozen. The apparatus is convenient but not really necessary, and the process can be carried out in a fish kettle or a large, deep bowl or pan, but in this case householders are advised to stand the bottles on a false bottom, such as a piece of wood or a layer of hay, to avoid the risk of cracking the bottles.

The process of sterilising consists in filling the bottles with fruit, which must, of course, be prepared for the purpose by removing the stalks, etc., adding water to within half an inch of the rim and putting them in the steriliser, the temperature of which should be slowly raised to about 165° F. or 170° F., and kept at that point for about 10 minutes. The bottles should then be securely fastened down, being screwed or capped according to the system adopted, and allowed to cool. In this way a partial vacuum is secured in the bottles, and no harmful germs from outside can obtain entry if care is taken to ensure that the bottles are airtight.

Bottling in Ordinary Bottles or Jars.—If any difficulty is experienced in getting the proper types of bottles, ordinary glass jars may be used under the following conditions. If suitable corks or bungs can be got to fit the bottles, the fruit may be sterilised as described above, the cork being immediately pressed down tight and tied securely in its place. It should then be

coated with a layer of paraffin wax.* If, however, the glass jar has no such stopper, it can be sealed by pouring in, until full to the rim, immediately on removal from the steriliser, a thick layer of melted fat, or of a mixture made of $8\frac{1}{2}$ parts of vaseline and $1\frac{1}{2}$ parts of paraffin wax previously melted by warming. The melted fat or wax remains on the surface of the water in the bottle and on cooling solidifies and forms a thick seal. After the bottle has cooled the wax may be found to have contracted slightly in the neck; in this case it is well to pour on a further quantity of wax to fill the neck to the rim. The mouth of the jar should then be covered with parchment, such as is used to cover jam pots, and be tied firmly down. The filled jars should be stored in a cool room till required for use. Where ordinary bottles or jars are used it may be desirable to heat the contents to a rather higher temperature than that used in the vacuum process. The essential point in either system is that air containing harmful germs or spores of fungi should not be allowed to reach the fruit after sterilisation. So long as the seal used in the case of ordinary bottles remains perfect the fruit can be kept as successfully as in the vacuum process, but the seal may become damaged or may tend to crack owing to contraction of the wax, and germs may then obtain entry to the fruit. Bottles treated in this way should, therefore, be examined from time to time, and if imperfections in the seal are noticed they should be remedied.

The best fruits for bottling, whether by sterilising or otherwise, are gooseberries and plums, including damsons and stone fruit of this class. It is generally considered that the flavour of plums is improved by bottling. Any kind of fruit can be sterilised, if the necessary precautions are adopted, but it is improbable that it will be worth while to bottle apples or pears during the season of 1915.

3. *Fruit Drying.*—Directions were given in this *Journal*, September, 1914, p. 548, for drying plums and apples. The crops will probably not be heavy enough to make this process profitable this year, and it may be difficult to get the necessary apparatus.

4. *Prune-making.*—A simple method of dealing with plums is known as prune-making. By this method the sugar in the plum is used in preserving the fruit, and there is less risk of subsequent decay if the fruit gets damp.

* This can be obtained from most chemists and should be melted and applied with a brush. Hard paraffin wax should be asked for. If this cannot be obtained a wax candle may be melted and used.

The apparatus in this case is of the simplest character, a few shallow trays being all that is required if the fruit is to be dried in an ordinary oven. A special apparatus can be obtained, if desired, for about £3.

Ripe fruit should be selected, but it must not be over ripe, or decayed or injured in any way. The temperature of the oven when the plums are first put in should be about 100° F.,* and the fruit should be kept at this temperature for about 8 hours. Care should be taken to examine the fruit from time to time, since after a few hours it begins to swell. The fruit should be watched and should be taken out before the skin bursts and replaced when the puffy appearance has subsided.

At the end of the first shift the trays should be taken out and the fruit allowed to cool. The oven should then be heated to a temperature of about 130° F. and the trays replaced for a second shift of from 8 to 10 hours, at the end of which time they should again be withdrawn and allowed to cool. The fruit should then be turned by placing an empty tray upside down on the top of a full tray and reversing them together. The oven should next be heated to a temperature of 170° F. and the trays inserted for a third shift of 8 hours. This should be continued till the fruit is dried, but the more slowly it is done the higher is the quality of the prunes. Some plums dry more quickly than others and these should be removed as soon as ready. The fruit when cool should be graded and packed in boxes and then stored in any place where a perfectly dry atmosphere can be secured.

The Making of Fruit Pulp.

As an article of food, fruit is generally used fresh, but there are various methods of preserving it, such as jam-making and fruit-bottling,† which make it available when fresh fruit cannot be obtained, and which in seasons of heavy crops form a valuable means of preventing waste. Among such methods "fruit-pulping" is not so widely known as it might be, but specially merits attention on account of its simplicity. It consists in reducing the fruit to a state of pulp by heat, generally by means of steam. The treatment sterilises the fruit, so that it may be kept under suitable conditions without decomposition for an indefinite period. The product is known as "fruit pulp." The process can be carried on by any grower who has on his premises an ordinary steam boiler.

* A thermometer registering to 250° F. and cased in metal can be purchased for about half-a-crown.

† See also Leaflet No. 250 (*Fruit Bottling for Small Holders*), and Special Leaflet No. 5 (*Fruit Preserving for Small Market Growers and for Domestic Use*), published above

Uses of Fruit Pulp.

Certain kinds of fruit pulp, such as apple, plum, damson, gooseberry and raspberry, are already made extensively in this country. Other kinds, such as apricot, are imported in quantity from countries where the kinds of fruit required are grown on a large scale and are cheap.

Fruit-pulp is chiefly used in jam-making. It is converted into jam where convenient to the manufacturer.

In recommending the making of fruit pulp the Board do not intend to suggest that the use of fresh fruit for jam-making should be curtailed. When possible, fresh fruit should be used for jam-making, since the product is superior and the expense of pulping as a preliminary to jam-making is avoided. Pulping is, however, a useful supplementary method: by its means larger quantities of fruit can be preserved, waste will be lessened, in plentiful seasons prices may be better maintained, and by the use of pulp stored up in seasons when fruit is cheap the cost of jam-making will be reduced in seasons when fruit is scarce.

Manufacture of Fruit Pulp.

Outfit.—The essential requirements for the preparation of fruit pulp on a commercial scale are a steam boiler, and barrels, tins, drums, or jars, in which the pulp can be stored. The best qualities of pulp are stored in large stone jars, but these are expensive. The quickest and most convenient method of storage on a farm is to use casks. Casks which have contained wine or spirits are usually employed. They should be in good, sound condition and preferably made of oak. Copper ladles and funnels are required for filling the casks.

Method of Making.—In a jam factory, pulp is usually prepared in the steam-heated pans otherwise used for boiling jam, but in the absence of special jam-making machinery the method here described may be adopted.

Three wooden vats, tubs, or half barrels should be placed in a row in a position convenient for connection with existing steam piping. Whilst the contents of one vat are being steamed, a second will be in process of filling, and a third being emptied, so that with a sufficient head of steam the process of pulping will proceed continuously. A coil of 1-in. copper piping is required. This should be pierced with not more than 20 $\frac{1}{8}$-in. holes. The coil should be placed in the vat or tub so as to reach to within a few inches of the bottom, and the pipe connecting it with the boiler should be fitted with a rapid coupling so that the coil

may be quickly transferred from one vat to the next. For continuous working two such coils are required, as it is not possible to insert a coil amongst the fruit after the vat has been filled. The vats should be provided with wooden covers to confine the steam whilst the steaming process is going on. With an 8 h.p. boiler working at a pressure of 45 lb., three vats of 100 gal. capacity can be kept in fairly continuous use. Five cwt. of plums or apples may be cooked at a charge, and, if steam can be maintained, three charges may be put through per hour.

Steam is also required for scalding out and sterilising the interior of the barrels before filling them with pulp.

The process of sterilisation is completed by burning a rag dipped in melted sulphur within the bung hole, and the bung is then kept closed until the barrel is ready for filling.

The casks must be completely filled and bunged down whilst the pulp is boiling hot, and placed in a position where they can be kept undisturbed until the pulp is required for use. They should lie on their side with the bung uppermost, and if there is any sign of fermentation a small hole should be bored in the wooden bung and closed with a spiggot. The latter should be lifted daily until fermentation has ceased and the contents of the cask have settled down.

If the casks are subsequently moved, the same process of daily opening the same hole in the bung must be repeated.

If tins or jars, after previous scalding, are filled with boiling pulp and at once hermetically closed, the contents should keep indefinitely without fermentation. Tins used for pulp should be well lacquered inside.

Addition of Water.—In making *plum* pulp by the above method there is no necessity to add water. Five cwt. of plums may be placed in the vat and the steam turned on for 10 minutes. The contents of the vat should then be thoroughly stirred, and the steam turned on for a further 10 minutes, at the end of which time the pulp should be ready. It is essential that not only the flesh but also the kernels of the plums should be thoroughly cooked and sterilised.

In making *apple* pulp a certain amount of water must be added, varying with the character of the apple. In the case of hard apples about 3 gal. of water should be sufficient for each cwt. of fruit, since more steam will be condensed than in the case of soft and easily cooked apples, to which rather more water may be added. After steaming for 15 to 20 minutes the apples must

be rubbed through a sieve of a mesh sufficiently small to retain the pips. The pulp must be again brought to the boil before finally storing in casks.

Autumn and Winter Fodder.

IN view of the short crops of hay obtained in some parts of the country farmers are naturally anxious to increase their stock of winter fodder. Considerable areas of aftermath are consequently being saved for cutting. This will to some extent reduce the area available for late grazing, and it becomes necessary to consider, especially in the event of a dry autumn, how a shortage of grass can be made good.

Maiden Seeds.—Sometimes a fair amount of autumn keep is furnished by "maiden seeds," but great care is necessary in the grazing of this crop if its future is not to be endangered. After the covering crop has been harvested the "seeds" should be rolled as soon as the implement is likely to make any impression on the ground. This will effect consolidation and promote tillering. Further, before being depastured the plants should be allowed to establish a firm and fairly deep root-hold as a precaution against winter frost, spring drought, and the risk of being uprooted by stock. At the same time, if a short-lived plant, such as red clover, be allowed to reach or even approach maturity in its first autumn, the chances are that, by spring, much of it will have died. Grazing will check this and encourage branching of such grasses as may have been included in the "seeds" mixture.

Straw.—It is generally possible in winter feeding to replace hay either wholly or partially by straw. For this purpose the straws in common use are those of oats, barley and wheat. One of the chief functions of straw in a ration is to provide the bulk necessary to the well-being of a ruminant animal. The nutritive value of straw is usually low, but much depends on the degree of ripeness of the crop when harvested. The riper the straw becomes the greater is the transference to the seed of the most valuable nutritive matters, and the tougher the straw is to masticate. In general, the straw of spring-sown cereals is less fibrous than that of winter-sown and is consequently more nutritious. Oat-straw is generally considered the most suitable for feeding, but barley straw, particularly if it contains a proportion of grass and clover plants, also forms useful fodder. Cereal straw is relatively rich in carbohydrates and uniformly poor in

albuminoids, and consequently in feeding straw to stock the farmer's chief concern is to augment the proportion of albuminoids in the ration. This can best be done by the addition of cakes or meals rich in that constituent.

The most economical way of feeding straw is to give it in the chaffed condition, mixed with other more nourishing and appetising food. For cattle it is usually mixed with sliced or pulped roots, crushed cake or meal, and treacle water, and allowed to stand overnight. A slight fermentation sets up which softens the straw and further adds to the palatability of the mixture.

In order to save straw for fodder the extended use of bracken and peat-moss as litter is desirable.

Potato Tops.—The crops commonly used for supplementing bare pastures are vetches, maize, cabbages, early turnips and mangold leaves, but where a sufficiency of these is not available, potato tops might be tried.

In times of stress farmers on the Continent frequently have recourse to potato tops as fodder for cattle. The tops should be cut soon after they begin, normally, to turn yellow, and be fed on grass land, but, as a precaution against the transmission of disease to future crops through the dung, should not be fed on grass which is to be broken up for potatoes in the following year. Green tops should be used very sparingly, preferably after being dried in the sun and wind. Tops bearing many blossoms or unripe fruits should be avoided, as these contain an undue amount of a poisonous principle.

The tops should be collected as free from earth as possible and be fed in small quantities along with other food.

White Mustard grows very rapidly and may be broad-casted upon stubbles broken up by the cultivator or disc harrow. Sown as late as the end of August mustard will usually yield good food by the end of November. If not required for sheep feeding the crop may, with advantage, be ploughed in as green manure. From 14 to 16 lb. of seed, together with 1½ cwt. of superphosphate per acre, should be sown.

Reeds.—Another plant not to be despised in times of shortage is the reed. The common reed (*Arundo phragmites*), which grows luxuriantly in wet or marshy places is mainly used, if at all, for thatch and bedding. The straw is too coarse and brittle to make really good litter, but is admirably adapted for thatch, and where available may well be used for this

young reeds are suitable. The tops of the shoots are tender and succulent, and are readily eaten by stock. As the plant matures, however, it becomes almost incapable of digestion, and unless specially treated would be quite unfit for food. During June and July the more tender portions of the plant may be dried and chaffed, and fed instead of straw. Later the greener portions may be converted into silage, and thereby softened and rendered more palatable.

Care, however, should be taken to feed only small quantities along with roots and concentrated feeding stuffs.

Gorse or Furze, which grows naturally on waste places, was used formerly in this country as food for stock, and was even specially cultivated for that purpose. Two types are commonly met with—the ordinary prickly gorse, and " French " or foxtail gorse, which is relatively free from spines. The latter requires less preparation for stock-feeding and is, therefore, generally to be preferred, but ordinary gorse, once it has been thoroughly pulverised, may also be fed to stock with good results.

Gorse possesses the great advantage that it can be grown on poor, thin soils where other plants would fail, and it will greatly improve such soils by its growth. Naturally, however, it thrives best on good, well-drained soils : it will not do well on cold clays or damp peaty soils, or on chalk.

Where foxtail gorse is specially grown for fodder the seed is drilled in rows 12 to 24 in. apart in April or May, on clean ground, at the rate of 12 to 15 lb. per acre. Gorse seedlings are slow in growth, and it is most important, therefore, that weeds should be kept in check. The first cutting is usually made in the second winter after sowing, from November to the end of February. Thereafter the crop may be cut annually or biennially as found expedient.

In an experiment conducted on light, sandy land at Woburn " French " gorse yielded 11 tons per acre in its second winter.

Before being fed to stock, gorse is generally crushed between rollers, or otherwise pulverised. It should not be allowed to lie for long in bulk as it ferments and quickly becomes sour and unpalatable. In the case of old-established gorse, only the green tops are fit for feeding. Old gorse covers, however, may be reclaimed by cutting down the woody plant, as close to the ground as possible, and freely dividing the roots. Subsequent young growth will be available for cutting at one or two years' growth, as may be required.

Gorse is a highly nutritious fodder, and has proved satisfactory with all classes of farm live stock, more particularly

with horses and milch cows. It should form, however, only part of the ration, as when fed in excess it proves too heating. This effect may be counteracted by giving occasionally a bran mash or a daily allowance of roots. Horses and cows may receive up to 20 lb. per head daily. In the Woburn experiment already referred to the gorse was put through a gorse-cutter and fed to sheep on swedes. In the fresh state the sheep ate, readily, up to 2½ lb. per head daily, and throve well upon it.*

Particulars in regard to Catch Crops to come in for use in early spring will be found in Special Leaflet No. 28. (*Suggestions for the Cultivation of Catch Crops and Home-Grown Feeding Stuffs.*)

Notes on Feeding Stuffs in August: From the Animal Nutrition Institute, Cambridge University.

THESE notes should be read in conjunction with the notes in the last five numbers of the *Journal*, where the meaning of food units and the method of compiling the table of prices and values is explained.†

Feeding stuffs have, on the average, altered little in price since last month. Individually, however, there have been several noteworthy changes. Wheat offals, especially sharps and middlings, are considerably dearer, and bran has also gone up slightly. Argentine maize has dropped considerably.. Malt culms and wet brewers' grains are cheaper. Oats have gone down appreciably, but are still so dear as to be out of the question except for very special purposes.

Undecorticated cotton cake is again dearer, and at its present price is a most uneconomical food to buy. It is far dearer per food unit than linseed cake, although the latter is still rising in price. At present prices decorticated cotton cake is very cheap per food unit, and so are the less known cakes made from palm-nut kernels, coconuts, and soya beans. These latter will no doubt be further used as their feeding properties get better known. Palm-nut kernel cake was used for fattening oxen at the Norfolk Agricultural Station last winter with considerable success. Mixed in equal proportions with cotton cake it was given to oxen at the rate of 7 lb. per head per day, along with normal rations of chaff and roots.

---

* Dr. J. Augustus Voelcker: *Journal R.A.S.E.*, Vol. X., 1899.

† This *Journal*, March, 1915, p. 1111; April, 1915, p. 52; May, 1915, p. 148; June, 1915, p. 248; and July, 1915, p. 322.

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate prices per ton at the end of July.				Approximate prices per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya Bean Cake	1 : 1·1	122·3	8 3 9	8 7 6	8 0 0	8 5 0	1 4	1 4¼	1 3¾	1 4¼
Decorticated Cotton Cake	1 : 1·3	126·3	9 5 0	10 10 0	—	10 5 0	1 5½	1 8	—	1 7¾
Indian Linseed Cake	1 : 1·9	123·1	10 5 0	10 5 0	10 2 6	—	1 8	1 8	1 7¾	—
English Linseed Cake	1 : 2·0	120·1	10 15 0	11 5 0	10 5 0	10 17 6	1 9¾	1 10½	1 8½	1 9¾
Bombay Cotton Cake	1 : 2·4	65·3	—	7 0 0	—	7 0 0	—	2 1¾	—	2 1¾
Egyptian Cotton Cake	1 : 2·0	71·9	6 15 0	7 12 6	7 0 0	7 5 0	1 10¼	2 1½	1 11¼	2 0
Coconut Cake	1 : 3·8	102·6	7 3 9	—	—	7 5 0	1 4¾	—	—	1 5
Palm-nut Kernel Cake	1 : 4·0	83·5	6 0 0	5 5 0	5 12 6	6 7 6	1 5¼	1 3	1 4¼	1 6¼
English Beans	1 : 2·6	99·5	9 13 9	10 10 0	9 5 3	9 13 0	1 11¼	2 1½	1 10¼	1 11¼
Chinese Beans	1 : 2·6	101·2	9 18 4	—	—	—	1 11¼	—	—	—
English Maple Peas	1 : 3·2	97·2	11 11 0	—	11 11 0	—	2 4¼	—	2 4¾	—
English Dun Peas	1 : 3·2	97·2	10 4 6	—	9 15 6	—	2 1¼	—	2 0¼	—
Calcutta White Peas	1 : 2·3	97·5	13 6 8	12 17 6	—	—	2 9	2 7¾	—	—
American Maize	1 : 11	93·8	7 18 8	9 8 6	—	—	1 8¼	2 0	—	—
Argentine Maize	1 : 11	94·2	7 4 8	7 12 0	7 11 6	7 9 0	1 6¼	1 7¼	1 7¼	1 7
Maize Meal	1 : 13	86·5	8 5 0	8 10 0	8 10 0	7 17 6	1 11	1 11½	1 11½	1 9¾
Maize Gluten Feed	1 : 3·3	121·6	7 15 0	—	—	8 5 0	1 3¼	—	—	1 4¼
Maize Germ Meal	1 : 8·4	99·2	7 15 0	8 10 0	8 7 6	8 10 0	1 6¾	1 8½	1 8½	1 8¾
English Feeding Barley	1 : 7·8	83·0	10 1 6	11 4 0	10 7 0	10 12 6	2 5	2 8½	2 6	2 6¾
English Oats	1 : 7·9	75·4	12 6 8	11 16 0	11 10 0	10 10 0	3 3¼	3 1½	3 0½	2 9½
Argentine Oats (Buenos Ayres) ..	1 : 7·9	75·4	9 7 10	} 10 12 0	10 17 3	10 6 0	2 6	2 9¾	2 10¼	2 9
Argentine Oats (Bahia Blanca) ..	1 : 7·9	75·4	9 19 0				2 7¾			
Malt Culms	1 : 3·6	69·9	5 12 6	6 5 0	5 0 0	6 0 0	1 7¼	1 9¼	1 5¼	1 8¼
Brewers' Grains (dried) { mixed ..	1 : 3·4	84·5	6 10 0	—	6 10 0	6 10 0	1 6¼	—	1 6¼	1 6¼
Brewers' Grains (dried) { distillery ..			7 0 0				1 8			
Brewers' Grains (dried) { fine ale ..			6 15 0				1 7¼			
Brewers' Grains (wet) { mixed ..	1 : 3·4	21·1	0 14 0	—	1 4 0	—	0 8	—	1 1¾	—
Brewers' Grains (wet) { ale ..			0 15 0				0 8½			
Brewers' Grains (wet) { porter ..			0 13 0				0 7½			
Egyptian Rice Meal	1 : 10·5	78·7	—	—	7 5 0	—	—	—	1 10	—
Burmese Rice Meal	1 : 10·3	78·7	6 5 0	6 10 0	—	7 0 0	1 7	1 7¾	—	1 9¼
Wheat Middlings..	1 : 5·3	93·4	8 10 0	—	—	—	1 9¾	—	—	—
Wheat Sharps	1 : 5·3	86·3	8 5 0	8 12 6	8 15 0	8 0 0	1 11	2 0	2 0¼	1 10¼
Wheat Pollards	1 : 5·3	81·9	—	6 5 0	—	—	—	1 6¼	—	—
Wheat Bran	1 : 5·3	77·5	6 2 6	6 2 6	5 15 0	5 10 0	1 7	1 7	1 5¾	1 5
Wheat Bran (broad)	1 : 4·7	79·9	7 15 0	6 15 0	6 15 0	6 10 0	1 11¼	1 8¼	1 8¼	1 7¼

The cattle ate it readily, and made equal increases with a similar lot getting linseed cake in place of the palm-nut kernel cake, other conditions being the same. The cattle were sold by auction at the local market, and, judging by the prices realised per cwt. for the individual animals, the butchers seemed to have a slight preference for the appearance of the oxen fed on palm-nut kernel cake. The present price of about £6 per ton works *out at only* 1*s*. 4¾*d*. *per food unit*, and at this price palm-nut kernel cake should be largely used for fattening oxen next winter.

Average Prices per Food Unit at the Four Markets of the 31 Feeding Stuffs, shown on page 457.

	s.	d.		s.	d.
Brewers' grains (wet) ..	0	10¾	Wheat middlings ..	1	9¾
Maize gluten feed ..	1	3¾	Rice meal, Egyptian ..	1	10
Soya bean cake.. ..	1	4¼	Maize, American ..	1	10¼
Palm-nut keirnel cake ..	1	4¾	Maize meal	1	11
Coconut cake	1	5	Beans, English	1	11½
Wheat bran	1	6¼	Wheat Sharps	1	11½
Wheat pollards	1	6¼	Beans, Chinese	1	11½
Brewers' grains (dried) ..	1	6¾	Cotton cake, Egyptian ..	1	11¾
Decorticated cotton cake	1	7	Peas, English dun ..	2	0¾
Maize, Argentine ..	1	7	Cotton cake, Bombay ..	2	1¾
Malt culms	1	7¾	Maple peas, English ..	2	4½
Linseed cake, Indian ..	1	8	Feeding barley, English	2	6½
Maize germ meal ..	1	8	White peas, Calcutta ..	2	8¼
Rice meal, Burmese ..	1	8	Oats, Argentine	2	9
Wheat bran (broad) ..	1	8¾	Oats, English	3	0¾
Linseed cake, English ..	1	9½			

Coconut cake has been tried for milking cows this summer on the University Farm. The cows did not take it readily at first, but by introducing it gradually to their diet they very soon got used to it and ate it well, with satisfactory results as regards their milk yield. At its present price of about £7 5*s*. per ton it works out at only 1*s*. 5*d*. per food unit, and is a very cheap concentrated food for cows. Soya bean cake is by now fairly well known. Oxen do well on it if it is used with discretion. Not more than 2 or at most 3 lb. should be included in the daily ration, and to counteract its somewhat laxative properties cotton cake or some similar astringent food should be included. At about £8 5*s*. per ton, its present price, or only 1*s*. 4¼*d*. per food unit, soya bean cake is, with one exception, the cheapest concentrated food on the market, the exception being gluten feed, which is 1*s*. 3¾*d*. per food unit. This latter is a sound concentrated feeding stuff for milking cows.

It may not be out of place to remind those who have to buy in feeding stuffs for the winter that transport is at present very slow, and the delivery of orders left to the last moment

is apt to be so long delayed that it may become necessary to buy whatever can be obtained locally and at a very high price.

Where early delivery is accepted it is necessary to take great care in storage. The building should be dry, and cakes should be raised a few inches off the floor and placed on their edges rather than on their sides, so that as soon as the slightest heat sets in an upward draught of air is caused which dries the cakes and stops the heating.

Suggested Rations for August.

Horses.—August is the month of harvest, and harvest means hard work for the horses. If hard work is expected the feeding must be liberal. It is a very common practice to green soil the horses during harvest. Where leguminous green crops, lucerne, sainfoin, tares or clover are available for this purpose the following makes an economical ration of dry food at present prices: 4 lb. crushed maize, 2 lb. bran, and 1 lb. bean meal. If the green stuff is rye-grass mixture with only a little clover, maize or other non-leguminous fodder, or if the horses are turned out on grass which does not contain much clover, the bean meal should be increased to 2 lb.

When long shifts are worked on dry food it is necessary to water the horses frequently, at least once in 4 hours.

Milking Cows.—At the present high price of milk it is good economy to give a fair ration of concentrated food to cows at grass. If this is not done the milk yield is apt to fall off this month. The following mixtures are suitable at present prices:—1 part coconut cake, 1 part maize and 1 part bran; or 1 part decorticated cotton cake and 2 parts maize; or 1 part maize gluten feed and 1 part bran. The ration should vary according to yield of milk; all cows should get 2 lb. of the mixture per day, and those giving over 2 gallons an extra pound per half gallon.

If lucerne, clover, or sainfoin is available for green soiling the dry food may be reduced to 1½ lb. per head per day, of course with proportionate extra food for the heavier milkers.

If the grass runs short and milk prices keep at their present level, it is good economy to use bran in addition to the above, the amount being proportional to the shortage of grass, up to 5 lb. per head per day when the grass gives out entirely. When cows are green soiled on maize they should get an extra pound per head of bean meal; very heavy milkers may get as much as 2 lb.

Baby beef: see rations recommended last month.

Stores at Grass should be pushed on if they are intended for beef. Those between 10 and 12 months old may get 1 lb. decorticated cotton cake and 1 lb. maize meal daily. This

ration may be doubled for stores about 15 months old. An alternative ration for the latter is 2 lb. coconut cake and 2 lb. cotton cake.

Lambs and Pigs: see rations suggested last month.

Meat Export Trade of Australia.

ON the 5th June, 1914, the Australian Government appointed a Royal Commission to enquire into the operations of any person, combination or trust tending to create any restraint of trade or monopoly in connection with the export of meat from Australia. The report of the Commissioner (Cd. 7896, price 5½*d.*) has recently been issued.

In his preliminary remarks the Commissioner refers to the general conditions under which the trade is carried on. He points out that the States place no restrictions on any person who desires to engage in the trade. The regulations are mainly confined to ensuring that exported meat is free from disease, and a certificate to this effect must be obtained from the inspector appointed for the purpose at the slaughtering establishments before the meat can be passed as fit for export. After it has been passed the meat is stamped and, unless it is in the form of preserved meat, it must be placed in a cool store kept at a temperature not exceeding 20° F. The meat must not be removed from the cold store without the authority of a departmental officer. In some States the practice is to carry out an ante-mortem examination as well as the usual post-mortem examination. The Commissioner suggests that all the States should be brought into line in this respect.

The total numbers of sheep and cattle reared in all the States in 1913 show a substantial increase over the corresponding totals for 1901. The Commissioner, however, does not consider this increase satisfactory and points out that the present production of beef, mutton, and lamb suitable for export is not commensurate with the capacity of the Commonwealth. Owing to the greater prosperity of the poorer classes in England the demand for frozen meat is increasing, and if it be found possible to proceed with the schemes for closer settlement, the Australian stock-raising industry, especially in the central and northern parts, should undergo a great expansion. Recently, a number of additional meat factories have been erected, and existing factories have been extended. The chief difficulty in Queensland has been to obtain a regular supply of cattle suitable for the export trade all the year round, but it is hoped that in time this difficulty will be overcome.

Another point to which the Commissioner called attention was the export of veal. The export of veal has recently increased

considerably, especially to the United States, and in view of the danger of an unrestricted slaughter of calves it is suggested that the matter is sufficiently serious to call for further consideration with a view to action, if necessary, of a preventative character.

The remainder of the report deals mainly with what was in effect the chief object of the enquiry, *i.e.*, to determine the effect on the Australian meat export trade of the American Beef Trust and other combinations of a similar nature. After drawing attention to the operations of these combinations in other countries the Commissioner traces in detail their operations so far as the Australian trade is concerned. The main conclusions arrived at are as follows:—

The Swift Beef Company, the Morris Beef Company, and Armour and Company, the American companies trading in the United Kingdom, which belong to the group popularly known as the American Beef Trust, have been purchasers of Australian meat, through distributing agencies abroad, for some considerable time. Together with other companies they have also made purchases for shipment to the United States.

There is nothing to indicate that these purchases were not made under ordinary competitive conditions or that there is anything in the shape of combination or concerted action on the part of these companies in Australia. The Commissioner suggests, however, that their operations should be closely followed, and recommends that for this purpose the Australian Government should invite the co-operation of the several States. The assertion is one which concerns the Imperial and Argentine Governments as well as the Australian Government, and it is suggested that a frequent interchange of communications, with a view to concerted action against any detrimental combination, should be arranged.

The Commissioner adds that it was not shown that there is any agreement among exporting firms for the purpose of suppressing competition or fixing or regulating prices.

Suggestions for Increasing the Egg Supply.

THE attention of all poultry-keepers is directed to the importance of securing as large a production of eggs as possible during the coming autumn and winter, both in order to reduce the deficiency in our supplies caused by the very restricted quantity of imported eggs, and to secure and retain the best class of trade in home markets.

It is very important that every poultry-keeper should retain the best birds for laying, and make careful selection of the birds which are to be carried over the winter.

Though the price of feeding stuffs has risen, there is no reason to assume that well selected hens and pullets will not yield an adequate return under careful management.

Preservation of Pullets.—No pullets which are capable of producing eggs in the autumn or winter should be killed. To kill such pullets is to decrease the possible food supply, and is wasteful.

Selection of Birds for Laying: Killing Old Hens, &c.—In order to maintain only those birds which are likely to be profitable, "old" hens, hens which have completed their second season, and superfluous cocks and cockerels should be sold; birds which are suffering from disease should be destroyed; and an endeavour should be made to increase the stock of pullets and young hens reserved for laying.

Management of Moulting Hens.—Special attention should be given to the management of hens during the moult. The birds should be examined carefully; they will probably moult most successfully if in slightly lean condition at the outset; birds which are too fat may be put on half rations. When the new feathers form the birds should be fed rather more liberally. The supply of green food should be abundant, and, unless they have a wide range, animal food should be added to the ration.

Use of Home-grown Produce.—Produce grown on the holding should be used as much as possible for feeding the birds; the quantity of vegetables used in the mash may be increased; feeding should be regular, but without waste of food; the ground occupied by the birds should be changed periodically, wherever it is possible; houses should be weatherproof, well lighted, well ventilated, and regularly disinfected.

The Cultivation of Seaweed in Ireland.*

AT the present time, owing to the scarcity of potash occasioned by the war, the value of seaweed in providing a source of supply of a certain amount of potash should not be overlooked. The fullest possible use should be made of all the seaweed obtainable from natural sources, and, since it can be and is artificially cultivated, the question of an extension of such cultivation deserves earnest consideration.

Seaweed contains about as much nitrogen as farmyard manure, but in a rather less valuable form, about half as much phosphates and considerably more potash.† It supplies a large quantity of organic matter, and has a special value

* *Journ. Dept. of Agric. and Tech. Instr. for Ireland*, April, 1915.

† Full particulars as to the composition and use of seaweed as a fertiliser are given in Leaflet No. 254 (*The Use of Seaweed as Manure*).

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

Influence of Copper and Lead Salts on Wheat (*Woburn Pot Culture Experiments*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—The copper salts tested in 1914 were the sulphate, phosphate, carbonate, nitrate and arsenite, the amounts of copper applied to soil being ·10, ·05, ·02, ·01 and ·005 per cent. respectively in the case of each salt.

The general conclusions drawn are: (1) That copper in the form of sulphate of copper has an injurious effect when used in quantity supplying ·05 per cent. of copper or more, but that ·02 per cent. of copper, or less than this, can safely be used in this form and has a slightly stimulating effect.

(2) That copper in the form of phosphate of copper has a generally stimulating influence, and can be used in quantities supplying up to ·10 per cent. of copper without producing any toxic effect on the plant.

(3) That copper in the form of carbonate of copper is nearly as harmful as sulphate of copper, when used in quantities approaching ·10 per cent. of copper. With ·05 per cent. the effect is doubtful, but ·02 per cent., or less than this, has, when used in the form of carbonate, a stimulating influence.

(4) That copper in the form of nitrate of copper when supplying ·02 per cent. of copper or more is distinctly harmful, but when used in less amounts has a stimulating influence.

(5) That copper in the form of arsenite of copper is very harmful, and that even so small a quantity as ·05 per cent. of copper in this form may be toxic in its effects.

The salts of lead tested were the phosphate, carbonate, nitrate, sulphate, and chloride. Although the salts supplied up to ·10 per cent. of lead there was no sign of injury to the wheat, a stimulating effect being generally caused. This was especially marked with the phosphate and nitrate; with the carbonate and sulphate the results were very similar to the untreated, and with the chloride the straw seemed to be somewhat reduced.

Influence of Magnesia on Wheat and Mangolds (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—With wheat, in 1914, magnesia produced plants of a much darker green colour, induced more tillering and gave a more nitrogenous grain. The effect on the yield was not determined owing to the ravages of birds.

Mangolds were grown on soil which had received magnesia in 1912, no magnesia being given in 1913 or 1914. The leaves of the mangold plants were much darker in colour on the plot which had received magnesia than on the untreated plot, and an increased yield of 14 cwt. of roots per acre was obtained.

Inoculation of Crops with Peat Preparation (*Woburn Pot Culture Expts.*; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—The peat preparation tested was introduced by Prof. Bottomley; with it was

* *A summary of all reports on agricultural experiments and investigations recently received is given each month. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.*

compared heated ordinary Fen soil, the latter having given good results at Woburn in the past, in order to discover whether any results obtainable from the peat preparation might not be due purely to the organic and nitrogenous matters supplied.

The crops tested were barley, peas and mustard, and the peat preparation (one part to eight of soil) and the heated Fen soil were added to the top six inches of soil in the pots. Compared with untreated soil, the peat preparation produced crops of mustard and barley much darker in colour (the barley having a broader flag) and with peas a stronger growth and better colour. The results with peas were vitiated by blight; those from mustard and barley were as follows:—

—	Mustard. Weight of green crops.		Barley.	
	1st Crop.	2nd Crop.	Corn.	Straw.
	grms.	grms.	grms.	grms.
Ordinary soil	59·6	12·3	18·1	25·5
Ordinary with peat preparation	163·3	20·6	19·6	33·5
Ordinary with heated Fen soil	71·8	20·0	14·0	27·1

With tomatoes the peat preparation was compared with nitrate of ammonia, both being applied (*a*) once, with and without phosphate of potash, (*b*) twice, with and without phosphate of potash. The nitrate of ammonia was used in such quantity as to supply the same amount of nitrogen as the soluble nitrogen in the peat preparation. During the period of growth the tomatoes treated with the peat preparation were invariably of darker green colour than the rest. The following weights of fruit were obtained:—

—	Applied once, alone.	Applied twice, alone.	Applied once with phosphate of potash.	Applied twice with phosphate of potash.
	grms.	grms.	grms.	grms.
No treatment	1,114	—	—	—
Peat preparation	1,206	965	1,127	893
Nitrate of ammonia ..	1,211	1,096	1,043	1,285

MISCELLANEOUS.

The Use of Rice Flour for Bread (*Comptes Rendus des Séances de l'Académie d'Agriculture de France; Séance du 9 Juin, 1915*).—This paper did not deal with the question of whether the present or future economic situation in France would render necessary the authorisation of the addition of rice flour in making bread. The investigations described showed that the use of rice flour altered the appearance of the loaf, made its manufacture more difficult, and decreased its nutritive valne, and that the only advantage to be derived was an economy which would only be felt by institutions consuming large quantities of bread.

Agricultural Returns for Ireland.

THE following Preliminary Statement, issued by the Department of Agriculture and Technical Instruction for Ireland, shows the numbers of live stock and the acreage under certain crops on 1st June, 1914, and 1st June, 1915.

TABLE I.

Table showing the numbers of certain descriptions of Live Stock in Ireland on 1st June, 1914, and 1st June, 1915.

Description of Live Stock.	Numbers on 1st June.		Increase (+) or Decrease (—).	
	1914.	1915.	Number.	Percentage.
Horses—				
Used for Agricultural Purposes	393,646	356,460	— 37,186	— 9·4
Unbroken—				
One year old and upwards	96,790	76,680	— 20,110	—20·8
Under one year ..	55,933	53,964	— 1,969	— 3·5
Cattle—				
Bulls	32,538	32,188	— 350	— 1·1
Milch Cows	1,548,790	1,509,668	— 39,122	— 2·5
Heifers in Calf	90,139	83,359	— 6,780	— 7·5
Other Cattle—				
Two years old and upwards	1,099,645	961,861	—137,784	—12·5
One year old and under two	1,141,461	1,065,016	— 76,445	— 6·7
Under one year ..	1,139,072	1,192,293	+ 53,221	+ 4·7
Total Cattle ..	5,051,645	4,844,385	—207,260	— 4·1
Sheep—				
Breeding—				
Rams	45,970	45,941	— 29	— 0·1
Ewes	1,408,262	1,431,316	+ 23,054	+ 1·6
Other sheep—				
One year old and upwards	673,407	643,922	— 29,485	— 4·4
Under one year ..	1,472,942	1,478,340	+ 5,398	+ 0·4
Total Sheep ..	3,600,581	3,599,519	— 1,062	0·0
Pigs—				
Breeding—				
Boars	1,938	1,900	— 38	— 2·0
Sows	133,188	122,020	— 11,168	— 8·4
Other Pigs—				
Six months old and upwards..	173,816	148,516	— 25,300	—14·6
Under six months ..	996,696	932,599	— 64,097	— 6·4
Total Pigs ..	1,305,638	1,205,035	—100,603	— 7·7
Poultry—				
Total Poultry ..	26,918,749	26,041,017	—877,732	— 3·3

TABLE II.

Table showing the acreage under certain crops in Ireland on 1st June, 1914, and 1st June, 1915.

Crops.	Acreage on 1st June.		Increase (+) or Decrease (—).	
	1914.	1915.	Acreage.	Percentage
Wheat	36,913	87,116	+50,203	+136·0
Oats	1,028,758	1,078,297	+49,539	+ 4·8
Barley	172,289	142,544	—29,745	— 17·3
Potatoes	583,069	594,801	+11,732	+ 2·0
Turnips	276,872	264,963	—11,909	— 4·3
Mangolds	81,570	84,128	+ 2,558	+ 3·1
Flax	49,253	53,233	+ 3,980	+ 8·1
Hay—				
First year	532,486	526,502	— 5,984	— 1·1
Second and Third Years	407,255	385,160	—22,095	— 5·4
Permanent Meadow ..	1,547,772	1,609,648	+61,876	+ 4·0

Agricultural Returns for Scotland.

THE Board of Agriculture for Scotland have prepared provisional estimates of the acreage of wheat, barley, oats, potatoes and hay and the numbers of each class of live stock in Scotland, based on a proportion of the returns made on 4th June last. The figures are given in the following table, with a comparison with those for 1914. It will be observed that wheat and oats show increases of 18,000 and 77,000 acres respectively while barley shows a decrease of 44,000; the total area under these three crops is thus larger by 51,000 acres. While certain classes of live stock have diminished, the total numbers of cattle, sheep and pigs show slight increases.

The usual Preliminary Statement of the Agricultural Returns will be issued when the tabulation has been completed.

Class of Stock.	Number.	Increase or Decrease as compared with 1914.	Per Cent.
Cows in Milk	361,000	— 3,000	— 0·8
Cows in Calf	43,000	— 1,000	— 2·3
Heifers in Calf	44,000	— 2,000	— 4·3
Other Cattle, 2 years and above	229,000	—13,000	— 5·4
„ „ 1 year to 2 years ..	299,000	+28,000	+10·3
„ „ under 1 year ..	252,000	+ 4,000	+ 1·6
Total of Cattle	1,228,000	+13,000	+ 1·1
Ewes for Breeding..	3,038,000	+63,000	+ 2·1
Other Sheep over 1 year	1,196,000	+29,000	+ 2·5
„ „ under 1 year ..	2,868,000	—16,000	— 0·5
Total of Sheep	7,102,000	+76,000	+ 1·1
Sows for Breeding	18,000	— 1,000	— 5·3
Other Pigs	140,000	+ 7,000	+ 5·3
Total of Pigs	158,000	+ 6,000	+ 3·9

Crop.	Acreage.	Increase or Decrease as compared with 1914.	Per Cent.
Wheat	79,000	+18,000	+29·5
Barley	150,000	—44,000	—22·7
Oats	997,000	+77,000	+ 8·4
Potatoes	144,000	— 8,000	— 5·2
Rye Grass, etc., for Hay	388,000	—20,000	— 4·9
Permanent Grass for Hay ..	151,000	— 6,000	— 3·8

OFFICIAL NOTICES AND CIRCULARS.

Issue of Special Leaflets.

THE purpose of the Board's Special Leaflets was explained in the note in this *Journal* for September, 1914, p. 566, and lists of those issued have been given from time to time. Since the last list given (April, 1915, p. 87), the following have been issued:—

Special Leaflet No. 5.—Fruit Preserving for Small Market Growers or for Domestic Use. (*Revised.*)
,, ,, ,, 27.—The Manurial Value of Shoddy.
,, ,, ,, 30.—The Use of Forage Crops for Pig Feeding.
,, ,, ,, 31.—The Making of Fruit Pulp.
,, ,, ,, 32.—Village War Food Societies.
,, ,, ,, 33.—Suggestions for Increasing the Egg Supply.
,, ,, ,, 34.—Autumn and Winter Fodder.

Maintenance of Live Stock Act, 1915.

THE Maintenance of Live Stock Act, 1915, repeals the Slaughter of Animals Act, 1914, under which the Slaughter of Animals Order of 1915 was passed, but continues the Order in force. The Maintenance of Live Stock Act will remain in force during the continuance of the present war, and for a period of twelve months thereafter, and extends the powers of the Board so as to secure the maintenance of a sufficient supply of store as well as of breeding stock.

The Board are authorised by Order to:—

(*a*) Prohibit or restrict the slaughter of animals except male lambs;

(*b*) Prohibit or restrict the sale or exposure for sale of meat of immature animals which has not been imported;

(*c*) Authorise any local authority to execute and enforce the provisions of the Order, and provide for the manner in which the expenses of the authority are to be defrayed;

(*d*) Authorise any officer of the Board or of a local authority to enter any slaughterhouse or other premises on which animals are slaughtered for human food, and examine any animals or carcasses therein;

(*e*) Prohibit or restrict the movement of animals out of any area in which the slaughter of such animals is prohibited or restricted;

(*f*) Authorise or require the marking of animals for the purpose of an Order under the Act.

Any contravention of an Order made under the Act renders the offender liable, on conviction under the Summary Jurisdiction Acts, to a fine not exceeding twenty pounds, or if the offence is in respect of more than four animals, to a fine not exceeding five pounds for each animal.

Circular Letter as to the Slaughter of Animals Order of 1915.

THE Board of Agriculture and Fisheries have issued the following circular letter, dated 6th August, 1915, to Local Authorities, with regard to the Board's Slaughter of Animals Order of 1915:—

SIR,—I am directed by the President of the Board of Agriculture and Fisheries to bring to your notice the Slaughter of Animals Order of 1915, which prohibits the slaughter of an animal which is visibly or obviously in-calf or in-pig, and to the possibility of cases occurring of a sow that comes within the scope of Article 1 of the Order being sent to a market, saleyard or lair from which, under the provisions of the Board's Orders dealing with swine-fever the sow can be moved only to a bacon factory or slaughterhouse, where it must be detained until slaughtered.

In present circumstances Lord Selborne is prepared to deal exceptionally with such cases, and, with a view of avoiding the necessity of detaining in a market, saleyard or lair, or at a bacon factory or slanghterhouse until it has farrowed, a sow that comes within the provisions of Article 1 of the Slaughter of Animals Order, he has directed that favourable consideration shall be given to any application from the owner of such a sow for a special licence authorising its removal back to the premises from which it came, or to some other suitable premises, subject to such conditions as to subsequent detention and isolation as may be considered desirable. The Board would also be prepared to consider similarly an application in any case in which a visibly or obviously in-pig sow had been moved direct to a bacon factory or slaughterhouse.

It is, the President recognises, unfortunate that it should be possible for such cases to arise, but as at present no licence is required for the removal of a pig to such premises with a view to slaughter, they are, in fact, liable to arise; and it is considered that the amendment of the Board's Order of the 27th August, 1914, in this respect, by requiring a licence to be obtained before such movement, might undesirably add to the work of the County Police.

I am, &c.,

SYDNEY OLIVIER, *Secretary*.

Committee on Land Settlement for Sailors and Soldiers.

THE President of the Board of Agriculture and Fisheries has appointed a Departmental Committee to consider and report what steps can be taken to promote the settlement or employment on the land in England and Wales of sailors and soldiers, whether disabled or otherwise, on discharge from the Navy or Army.

The Committee is constituted as follows:—

Sir Harry Verney, Bart., M.P. (*Chairman*).
The Earl of Northbrook.

The Right Hon. Henry Hobhouse.
Major-General Sir Charles Crutchley, K.C.V.O.
Mr. Sydney Mager.
Mr. Vaughan Nash, C.V.O., C.B.
Mr. F. H. Padwick.
Mr. G. H. Roberts, M.P.
Mr. Leslie Scott, K.C., M.P.

The Secretary of the Committee will be Mr. F. L. C. Floud, Assistant Secretary to the Board of Agriculture and Fisheries, to whom all communications should be sent at 4, Whitehall Place, S.W.

Agricultural Labour.

THE President of the Board of Agriculture and Fisheries desires to draw the attention of farmers to the following arrangements that have been made by the Government Departments concerned to relieve the existing shortage in Agricultural Labour.

1. Instructions have been issued to General Officers Commanding-in-Chief and to Officers Commanding District that :—

(*a*) When there is no one over recruitable age available, a working farm bailiff or foreman, a head carter, horseman, and second horseman in the case of a large farm, or waggoner, a head stockman or yardman, a shepherd, and necessary milkers (until either women, or men not of recruitable age can be trained to take their place, or other means can be provided to replace them) should not be induced to enlist.

(*b*) Sufficient engine-drivers, blacksmiths and thatchers should be left, as far as possible, in every district.

2. Instructions have been given to pension officers not to raise questions in the case of existing old age pensioners in respect of any temporary iucrease of means due to the pensioner's re-employment on account of shortage of labour arising out of and during the war, provided that there is no evidence of a desire to pay, on account of the pension, less than the proper rates of wages.

3. Postmen who desire to work in the harvest and who are offered employment by farmers will be granted a period of special leave for that purpose.

Agricultural Labour.

THE President of the Board of Agriculture and Fisheries has the authority of the Secretary of State for War to announce that, having regard to the valuable work for the Nation which is being done by the engine drivers and mechanics employed by the proprietors of steam ploughs and threshing machinery, it has been decided to extend the concession made in respect of the recruiting of skilled farm hands to these men, who, therefore, should not be induced to enlist.

In the event of a difference of opinion arising between Recruiting Officers and farmers or proprietors of agricultural machinery with regard to the enlistment of special men, arrangements have been made for the Chairman of each Petty Sessional Division in England and Wales to select a magistrate to act as referee in cases of the kind. Particulars of the case for reference to a magistrate must be stated on a form which will be supplied by Recruiting Officers on request.

The form, when completed, should be forwarded to the Clerk to the Petty Sessional Division concerned, who will send it to the selected magistrate and arrange a day convenient to the parties for a hearing. At the hearing only the Recruiting Officer and the employer will be permitted to attend and be heard.

Hay for His Majesty's Forces.

IN consequence of the erroneous idea which prevails in some districts that the military authorities intend to commandeer the stocks of hay in the country at whatever price they deem reasonable and without regard to the amount required for use on the farm, the President of the Board of Agriculture and Fisheries desires to make known as widely as possible the policy of the Military Authorities in respect of the acquisition of hay.

1. The Military Authorities are ready to buy at its fair market value any suitable hay which is offered to their Purchasing Officers by the grower.

2. It is not the intention to acquire hay which is proved to be wanted for the use of the stock on a farm, and instructions have been issued to Purchasing Officers not to requisition hay actually required by a farmer for the use of his animals. Should any question arise on this point it is to be referred at once to the Forage Committee, who will take immediate steps to deal with it.

3. Soft meadow hay and clear clover hay is not required as a rule for Army purposes, but should seed mixture, sainfoin, lucerne, or upland meadow hay be purchased by anyone before it has been offered to and refused by the Military Authorities, such hay will be at once requisitioned.

4. In view of the short hay crop this year, the Military Authorities have decided to reduce materially the quantity of hay purchased in this country. This should ensure an adequate supply of hay remaining for farm stock and prevent inflation of prices, and it is possible that after the lapse of a few months the Military Authorities will not be large buyers in the Home Market at all.

5. Under the Army Acts, 1879 to 1915, any difference respecting the amount of payment when hay has been requisitioned shall be determined by a County Court judge, but with the object of preventing the inconvenience which an appeal to the County Court may cause, the Army Council have appointed for England and Wales a Committee for the Northern Area and one for the Southern Area for the purpose of hearing the views of the owner on the value of the hay requisitioned from him and the views of the District Purchasing Officer on the same. The Committee in each case will give their opinion on the price which should be paid for the hay in question, and this opinion the War Office will accept; but if the owner of the hay is dissatisfied with the opinion of the Committee which has considered his case it is still open to him to apply to the County Court judge.

6. Each Committee will consist of three members: (1) a farmer selected from one of the Farm Produce County Committees of the area concerned; (2) a hay merchant, and (3) an officer from the Purchasing Establishment of the War Office. The Secretary to each Committee is Lieutenant C. B. Rolfe, 64, Whitehall Court, London, S.W.

THE Board of Trade (Labour Exchange Department) have issued the following notes on war service for country women :—

War Service for Country Women.

(*a*) *For Organisers.*—There is a great deal of patriotism and energy and capacity for work running to waste among our village women at present for lack of a little organisation.

Women and girls living at home are longing to do their part in this great crisis ; farmers are at their wits end to find enough labour to get in their crops ; and neither seems to think of the other as the obvious solution of their difficulty. Something is being done in some places by importing trained whole-time women to work on the farms ; but the large supply of part-time workers on the spot is not being fully utilised.

There seems no reason, however, why all those willing and able to give a part of their time to farm work should not be enrolled on a register kept in each village, and be set to work on farms close to their homes, as they are wanted.

An informal meeting of all the women of all classes in the village should be held, and the plan explained, with plenty of discussion, both to the futnre workers, and to the wives of those likely to employ them. Somebody, preferably a woman, but in any case someone well known in the village, and popular, and living in a central position, should be chosen to keep this register, which need only be a copybook with its pages divided into colnmns for the worker's name and address, age, kind of work wanted, special qualifications, amount of free time, and lastly, the name of whoever engaged her.

At that same meeting the register could be made ; those present would be asked what they would and could do, and their names, etc., could be entered at once in the book. No serions offer of help of any kind should be refused. The real object is to awaken the spirit of co-operation in doing the men's work of food production during their absence ; and very often the practical labourer's wife will make most useful suggestions ; for instance, one Somerset woman who could not leave home at all, volunteered to wash and mend all the milking overalls to relieve the overworked farmer's wife ; and another, too delicate for farm work of any sort, volunteered to mind the small children of those fit for outdoor work. Both were at once entered on the register.

The keeper of the register should be in touch with the nearest Labour Exchange, so that her address may be given to both employers and employees applying to the Exchange from her neighbourhood. She could also be of great assistance by keeping a list of houses and cottages where imported whole-time women workers could be suitably lodged.

It is important that, wherever a register is started, the fact should be made known as widely as possible. An account of the meeting should be sent to the local paper, giving the name and address of the keeper of the register ; those present at the meeting should be asked to tell those who were not there about it ; a notice of the register, with the name and address of the registrar, can be put up in the post office and shop, and, most important of all, those who are willing to do farm work should *train* themselves for it ostentatiously. If, for instance, women and girls of high standing socially, who live in a dairying district, will at once learn to milk, and will let the other inhabitants see them going, in suitable working dress, to and from their work, day after day,

then their social inferiors will not be slow to follow their example, and the employers of labour will take them seriously. It is a good plan, too, for the women on the register to start growing vegetables on any unused bit of allotment or cottage garden; apart from the produce, it is proof that they are able as well as willing to dig and hoe and do any other garden work wanted from them.

It should be made plain from the first that all this War work should be paid for at a fair rate. Food is a most important part of our soldier's equipment. Once the possibility of a scarcity of food is realised by the women in our villages, they will be as keen to work on the farms at providing food, as the town women are to work in factories at providing munitions.

"Every woman who by working helps to release a man or to equip a man, for fighting, does National War Service."

(*b*) *For Workers.*—There are thousands of women and girls in our villages who are longing to do their bit of War work but who are unable to leave home to do so.

It seems obvious that for those who live in the country in this time of high prices for food, the right kind of War work is to help in every way practicable to produce and harvest as much food as possible. Without extra help from women there will be less instead of more food harvested this summer, because so many of our best men have joined the Army.

Most of us who live in the country have some spare time during the day, and with a little management we could make more. This might all be given to help in farm and garden work. Some of us could go milking once or twice a day; some of us could get all our usual work finished in the morning and help in hay or harvest field for the rest of the day; nearly all of us could help in picking fruit, both wild and garden varieties, for jam, and in making as much jam as possible this year; some of us could go out weeding and hoeing for the farmers; many of us could start keeping fowls or take more pains with the fowls we have already got, so that they shall be more productive; all of us can see to it that no ground is wasted in our own gardens that might be used for growing more vegetables for use in the winter. So let the farmers round about know that you are ready and willing to help them in any way you can; learn to milk at once; learn all you can about dairy work; let your neighbours know that you are ready to help them; it may be that War work for you will be in minding the children next door or in taking them all to pick blackberries while their mother works in the hayfield, because all the farmers' men have joined the Army.

In some places a register is being kept of all the women willing to do War service of any kind, so that farmers in need of help may be able to find out at once who is willing to give it. If such a register is being kept in your village, put your name down on it at once for whatever work you think you can best do; if not put your name down at the nearest Labour Exchange. All work done for the farmers will be paid for at a fair rate.

If you know of an allotment or bit of garden that is not being used, try and get it for growing more vegetables for your own use, or for sale during the coming winter.

If the War continues, a plentiful food supply will be all-important. All women who work to provide this are among those who " by working help to equip a man or to release a man for fighting; and are doing National War Service."

War Service for Women.

THE Labour Exchange Department of the Board of Trade have issued the following notes on agricultural work and training for women.

Women are needed for agricultural work, especially in the following branches :—

(1) Milking and dairy work.

(2) Care of cattle, pigs and poultry.

(3) Field and market garden work, *e.g.*, potato planting, weeding, thinning, hop-tying.

For milking and dairy work a course of training is necessary if the worker is to be in a position to command nearly full wages from the commencement. In the other branches useful work of some value from the wage-earning point of view can be rendered from the beginning, and experience may be rapidly acquired as a result of working under supervision for a short time.

The necessary training in milking and dairy work may be given by farmers who intend to employ the trained women on their own farms. It is impossible to forecast what vacancies of this nature may be notified to the Labour Exchanges from time to time, so that no general statement can be made as to the districts in which such openings may occur, or as to what arrangement may be made in regard to wages.

There are a few agricultural colleges and a limited number of private farms where a short course of training can be obtained on payment of a fee. The cost is usually about £1 per week for instruction, board and lodging.

In many counties there are travelling dairy schools which provide short courses of instruction, usually extending over about ten days, while a few County Education Authorities are now arranging special short courses of training with a view to preparing women for light farm work. Information in regard to these schools and courses can be obtained from the County Education Secretaries.

The Board of Agriculture and Fisheries have arranged for a strictly limited number of courses of training extending over two to four weeks, to be given at certain Agricultural Colleges. In these courses maintenance is provided and no cost is involved for the women under training. The courses are provided at present in Kent, Hampshire, Derby, Yorkshire, Cardiganshire, and Shropshire and will be provided at a later date in Carnarvonshire and Cumberland. The college authorities prefer to take students from their own county.

The Board of Agriculture and Fisheries have stated that 12*s*. to 15*s*. a week may be considered an average wage for women in agricultural work under present conditions. It is not possible to make any further general statement as to wages, housing, or other conditions, but full details will be given in connection with individual vacancies notified to the Labour Exchanges.

Applicants for agricultural work, however, should realise that the hours are necessarily long, and certain parts of the work must be done in the early hours of the morning and on Sundays.

A strong physique is essential.

Any woman who desires to obtain agricultural training should register her name and address at the Labour Exchange in the district in which she resides (the address of which can be obtained at the nearest Post Office) and inform the officer in charge what fees, if any, she is prepared to pay, and what work she feels best able to do. Her name will then be considered in connection with any suitable openings that may be notified to the Labour Exchange Department.

MISCELLANEOUS NOTES.

The Decline in the Agricultural Area of England and Wales.*

OF the 37,139,153 acres which, according to the latest measurements of the Ordnance Survey, make up the total area of England and Wales, 27,114,004 acres were returned as under crops and grass on the 4th June, 1914. This is 15,378 acres less than in 1913, and the *smallest total returned in any year since* 1877. This decline may be attributed in the main to the increase in the urban area, and to the constantly expanding demand for land for industrial purposes, which has been a normal feature since 1891. A noticeable point, however, is that the rate of decrease has been on this occasion greatly slackened: the average annual decrease between 1891 and 1913 having been very nearly 40,000 acres, and, except for 1906, when the decrease was only 12,000 acres, the present decline of 15,000 acres is the smallest that has been noted since the agricultural area first began to fall 22 years ago. The decline was general throughout the country, except in the west and south-west of England, where there was a small increase.

In addition to the area strictly under crops or grass, there are two other categories of land of an agricultural character, namely woodlands, and mountain or heath land which, while the herbage is too sparse or of too poor a quality to be regarded as pasture, is nevertheless utilised for grazing. This latter area was returned in 1914 as 3,781,565 acres, or some 23,500 acres less than in 1913. The inquiry as to the acreage of woodlands was not repeated in 1914; but, assuming that the figure of 1,884,068 acres returned in 1913 has remained practically constant, it would appear that 32,779,637 acres, or 88 per cent. of the total area of England and Wales, is either under cultivation, grazed, or woodland.

Short Course in Poultry Management.

A FOUR weeks' course on Practical Management of Poultry will be held at the South Eastern Agricultural College, Wye, Kent, commencing 1st September, 1915. The course is open to men and women—Fee, £3.

Residential accommodation can be obtained in Wye, close to the College, Farm and Gardens. Use may be made of the Horticultural Department of the College if those attending the course require instruction in Fruit and Vegetable Growing. For particulars, etc., application should be made to the Secretary.

* Agricultural Statistics, 1914, Part I.: Acreage and Live Stock Returns of England and Wales [Cd. 7926]. Price 6*d*.

Notes on Agriculture Abroad.

Establishment of a Plant Diseases Branch of the French Ministry of Agriculture.—By a Decree of 11th May, 1915, the French Ministry of Agriculture has established a branch for the study of plant diseases. The object of the Decree is to co-ordinate the work of the services and institutions already controlled by the Ministry of Agriculture, rather than to establish an entirely fresh department. The new service will comprise a number of stations already existing for the study of plant diseases, the phytopathological inspectors for agriculture and horticulture and the service for the control of imported seeds of forage plants. The Decree fixes the numbers and rates of remuneration of the inspectors and other officials, and provides for the employment of temporary assistance as well as the payment of grants to institutions and individuals for special research into plant diseases.

The establishment of the Phytopathological Service for the inspection of nurseries for the purpose of granting export certificates for horticultural produce was noted in this *Journal* for September, 1911, p. 516, and April, 1913, p. 75; by a Decree of 5th February, 1915, the operations of this Service were extended to include agricultural produce; the whole service is now, as stated, comprised in this new branch of the Ministry of Agriculture.—(*Bull. Mens. de l'Office de Renseignements Agricoles*, January–May, 1915.)

Inoculation of Cattle in Rhodesia against the Plasmoses.—The indigenous cattle of Rhodesia are small and slow to mature, and these defects can only be remedied by mating with bulls of improved types. It has been estimated by the Chief of the Animal Industries Branch of the Rhodesian Agricultural Department that at the present time 500 stud bulls are urgently required for this purpose. The mortality of cattle introdnced from oversea has, however, been so great as to render importation an extremely hazardous and costly proceeding.

It appears that, under existing conditions in Rhodesia, the ideal method of dealing with piroplasmosis and anaplasmosis is to supplement regular dipping with a simple and safe method of protective inoculation. To obtain such a method, a series of experiments was conducted on twelve shorthorn heifers imported from Great Britain. No success was obtained in the direction of the discovery of a specific therapeutic agent against anaplasmosis, comparable in effect to trypan blue in the treatment of piroplasmosis; but a very favourable virus was obtained, and six of the experimental animals upon which it was used suffered from mild reactions from which they recovered. These heifers are now being exposed to natural tick infection, which it is confidently believed they will resist. This virus and modifications of it are now being tested on the remainder of the consignment, and, if the favourable results are continued, it is hoped that within the near future the inoculation of imported stock may be undertaken with better results than hitherto. (*Rhodesia Agricultural Journal*, June, 1915).

Notes on Crop Prospects Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for July, 1915, issued by the International Institute of Agriculture, contains the following estimates of the production of cereal crops:—*Wheat*—England and Wales, 7,836,000 qr. in 1914-15 against 7,305,000 qr. in 1913-14; Italy, 23,877,000 qr., against 11,174,000 qr.; Russia in Europe (54 governments), winter, 37,678,000

qr., against 26,851,000 qr.; spring, 57,916,000 qr., against 44,791,000 qr.; Switzerland, 488,000 qr., against 410,000 qr.; United States, winter, 83,478,000 qr., against 85,601,000 qr.; spring, 36,865,000 qr., against 25,747,000 qr.; India, 47,908,000 qr., against 38,950,000 qr.; Japan, 2,958,000 qr., against 2,704,000 qr. *Rye*—Italy, 551,000 qr., against 613,000 qr.; Russia in Europe (54 governments), winter, 109,837,000 qr., against 91,836,000 qr.; spring, 846,000 qr., against 660,000 qr.; Switzerland, 246,000 qr., against 201,000 qr. *Barley*—England and Wales, 5,272,000 qr., against 6,172,000 qr.; Italy, 1,102,000 qr., against 830,000 qr.; Russia in Europe (54 governments), 59,014,000 qr., against 45,095,000 qr.; Switzerland, 72,000 qr., against 63,000 qr.; United States, 24,952,000 qr., against 23,387,000 qr.; Japan, 11,698,000 qr., against 10,960,000 qr. *Oats*—England and Wales, 9,098,000 qr., against 9,551,000 qr.; Italy, 3,179,000 qr., against 2,751,000 qr.; Russia in Europe (54 governments), 98,334,000 qr., against 74,084,000 qr.; Switzerland, 565,000 qr., against 533,000 qr.; United States, 143,447,000 qr., against 116,999,000 qr. *Maize*—The production in the United States in 1915 is estimated at 328,205,000 qr., against 311,737,000 qr. in 1914, an increase of 5·3 per cent.

France.—The condition of winter oats on 1st Jnly was officially estimated at 71 as compared with 67 in 1914; of spring oats 68 against 71; of winter barley 73 against 74; and spring barley 69 against 70. (80 = good, and 60 = fairly good). (*Broomhall's Corn Trade News*, 24th July.)

Holland.—H.B.M. Consul-General at Rotterdam, in a report relating to agricultural conditions on the 14th July, stated that rye and potatoes would probably yield rather unfavourably. Beans were generally fairly good to good, and peas mostly fairly good, while onions and sugar beet were good. The spring-sown corn crops had suffered from the drought, particularly oats. The areas under the crops were as follows:—Wheat 160,093 acres, as compared with 148,279 acres in 1914; rye, 548,728 acres, against 562,355 acres; barley, 63,146 acres, against 66,633 acres; oats, 350,382 acres, against 348,065 acres; horsebeans, &c., 38,925 acres, against 39,895 acres; under peas, 61,046 acres, against 64,788 acres; eating potatoes, 344,130 acres, against 346,501 acres; factory potatoes, 80,100 acres, against 77,136 acres; sugar beet, 141,012 acres, against 156,188 acres; onions, 7,556 acres, against 6,904 acres; and red clover, 68,167 acres, as compared with 72,371 acres in 1914.

Russia.—H.M. Commercial Attaché, Petrograd, stated that, according to the official "Trade Gazette" of Petrograd of the 26th June, the total area under sugar-beet on the 14th June was 1,895,834 acres as compared with 2,100,292 acres in 1914. The condition of the sowings in general was considered satisfactory, 38·8 per cent. being good, 38·6 per cent. being satisfactory, 14·6 per cent. unsatisfactory, and 6·08 per cent. bad.

Canada.—According to a bulletin, dated 11th June, issued by the Census and Statistics Office at Ottawa, indications pointed to an increase in the yield per acre of 15·6 per cent. for winter wheat, of 2·6 per cent. for spring wheat, and of 2·5 per cent. for rye, but to a

decrease of 1·5 per cent. for oats and 0·7 per cent. for barley, as compared with the average of the years 1910–1914.

United States.—The Crop Reporting Board of the Bureau of Statistics of the Department of Agriculture, in reporting as to crop conditions on the 1st August, states that the total production of winter wheat is estimated at 659,000,000 bush. as compared with a yield of 684,990,000 bush. last year; spring wheat at 307,000,000 bush. against 206,027,000 bush.; maize, 2,918,000,000 bush. against 2,672,804,000 bush.; oats, 1,402,000,000 bush. against 1,141,060,000 bush.; barley, 217,000,000 bush. against 194,953,000 bush.; rye, 44,000,000 bush. against 42,779,000 bush.; and linseed, 18,000,000 bush. against 15,559,000 bush.—(*The London Grain, Seed and Oil Reporter*, 9th August.)

Live Stock in France.—According to the census of cattle and sheep taken by the Ministry of Agriculture, the total number of cattle on 1st July was 12,286,849, compared with a total of 13,120,649 on 31st December, 1914, and the total number of sheep was 12,483,189, a decrease of 1,321,121, or about 10 per cent. (*London Grain, Seed and Oil Reporter*, 22nd July.)

Live Stock in Denmark.—The live stock statistics collected on the 15th May, 1915, place the number of horses at 525,690, compared with 567,240 on the 15th July, 1914, a decrease of 7·3 per cent.; of cattle at 2,416,471, against 2,462,862, a decrease of 1·9 per cent.; of sheep at 533,034, against 514,908, an increase of 3·5 per cent.; and of pigs at 1,918,627, against 2,496,706, a decrease of 23·2 per cent. (*Bulletin of Agricultural and Commercial Statistics*, July, 1915.)

Live Stock in India.—The numbers of live stock in British India (exclnding Bengal) are as follows:—Bulls and bullocks, 47,002,902 in 1912-13, against 37,085,104 in 1911-12, an increase of 26·7 per cent.; cows, 35,711,694, against 28,067,259, an increase of 27·2 per cent.; buffaloes: bulls, 5,235,503, against 4,659,775, an increase of 12·4 per cent.; cows, 12,471,983, against 12,091,450, an increase of 3·1 per cent.; young stock (calves and buffalo calves), 38,639,837, against 29,810,602, an increase of 29·6 per cent.; sheep, 22,934,265, against 22,848,043, an increase of 0·4 per cent.; goats, 28,683,583, against 28,554,832, an increase of 0·5 per cent.; horses and ponies, 1,554,830, against 1,539,945, an increase of 1·0 per cent. (*Bulletin of Agricultural and Commercial Statistics*, July, 1915.)

Agricultural Labour in England and Wales during July.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st August, the supply of labour was everywhere scarce, though farmers rarely fell behind-hand, except with turnip-hoeing, which was in many places much in arrears. In hop districts, the constant labour necessitated by the blight in the hop-yards contributed to delay in getting in the hay. Generally, the light hay crop helped the situation, but a good deal of apprehension was expressed regarding the corn harvest, as the demand for temporary labour will be increased by the fact that so much of the crop has been laid.

The following local summaries give further details regarding agricultural labour in the different districts of England and Wales:—

Northumberland, Durham, Cumberland, and Westmorland.—There was a general deficiency of labour especially for turnip-hoeing and hay-making; but the light hay crops prevented the difficulty from becoming acute.

Lancashire and Cheshire.—Labour was rather short, but there was no serious hindrance to farm work

Yorkshire.—Labour was very scarce and temporary labourers for turnip-hoeing and hay-making were difficult to get, but the position was saved by the character of the weather and the light hay crop.

Shropshire and Stafford.—Labour was scarce throughout the division.

Derby, Nottingham, Leicester, and Rutland.—Labour was still generally deficient. In some districts women and boys supplied temporary needs.

Lincoln and Norfolk.—Though there was a shortage of labour in some districts the deficiency did not, on the whole, cause serious trouble.

Suffolk, Cambridge, and Huntingdon.—The deficiency in the supply of labour seemed general throughout the division, and fears were expressed as to the prospects for harvest, especially if unsettled weather continues. In some localities more wages will be demanded for harvest labour; but so far wages do not seem to have risen generally.

Bedford, Northampton, and Warwick.—The supply of labour was short in most districts, especially in Bedford. The prospect of obtaining casual labour for the harvest was bad.

Buckingham, Oxford, and Berkshire.—Labour was generally deficient, and casual labour especially was difficult to obtain.

Worcester, Hereford, and Gloucester.—Labour was generally deficient, especially for turnip-hoeing and for cutting laid corn.

Cornwall, Devon, and Somerset.—The supply of labour was short, particularly casual labour for hoeing, &c.

Dorset, Wiltshire, and Hampshire.—The supply of labour was deficient, skilled ploughmen and milkers being particularly in demand. On some farms it was difficult to obtain labour for hoeing root crops.

Surrey, Kent, and Sussex.—On the whole there was a shortage of labour, but in some districts women had been helping with the hay harvest. The chief shortage had been experienced with hoeing, and some difficulty was expected with the harvest where the corn was beaten down. In spite of the shortage of labour the work on farms was generally well kept up.

Essex, Hertford, and Middlesex.—Labour was generally deficient, but farmers were managing. Prospects were less encouraging, as the effect of the storms, by laying the crops, was to increase the demand for harvest labour.

North Wales.—A general scarcity was reported from some districts. In others the supply of regular labour was sufficient, while temporary labour was scarce. The general supply of labour was better than was anticipated, and rates of wages for extra labour were lower than was expected.

Mid-Wales.—Labour in most places was rather short, but operations were not seriously hindered. In the south of Montgomery soldiers had been helping with the hay, and labour was abundant.

South Wales.—There was some general shortage of labour. In Glamorgan good reliable farm hands were in demand, but casual labour

was plentiful. In Carmarthen the supply of casual labour was reported to be deficient. In some districts slight increases in wages were made, especially for piecework or overtime.

Agricultural Conditions in England and Wales on 1st August.

THE Crop Reporters of the Board, in reporting on agricultural conditions in England and Wales on the 1st August state that the somewhat heavy rainfall of July was, upon the whole, beneficial to crops generally, which had suffered from too long a period of dry weather. Corn, roots, and pastures all show considerable improvement; on the other hand a good deal of corn has been laid by heavy storms, beans have deteriorated, and meadow hay has been damaged. Warm and sunny weather is now universally required.

Wheat shows a slight improvement, and the yield should prove nearly average. Harvesting—which should soon commence generally—will be rendered difficult in many districts, as many fields, especially the heavier crops, have been laid by storms. Barley and oats have very considerably improved during the month, although both are still well under average. A fair amount of winter oats has already been cut. Straw is still rather short. Beans have suffered from the weather, and there has been much blight; they have gone back on the month. The effect of the weather on peas has been variable, and, on balance, prospects remain about the same as on 1st July.

Potatoes have been much improved by the rain. Early varieties are rather light, but the main crop is more satisfactory, and the ultimate yield, on present appearances, should be about average. A little disease is reported as showing itself in several parts of the country.

Turnips and swedes have now got a good start since the rains. Much fly appeared during the dry weather, and a good deal of re-sowing has been necessary. Reports are, however, very variable; the crop is everywhere late, and fields are often patchy. In many districts the present condition as regards health and vigour is an average one, but elsewhere prospects are less promising. Mangolds have improved during the month, and the crop should ultimately fall not very much below the normal.

The seeds hay, which is a light crop, was mostly secured in good condition, at least in the southern part of the country, before the rain set in. But the change in the weather brought a check to hay-making, so that late crops of seeds, and the bulk of the meadow hay have been a good deal damaged, while hay-making has been much protracted. While the total yield of seeds hay is now considered to be very slightly greater than a month ago, there is no improvement noted in meadow hay, the extra growth induced by the rain being probably balanced by the damage caused by the heavy storms. The strawberry crop has proved below average on the whole, although several districts have been favoured with large crops. Other small fruit crops have been about average: raspberries rather more, currants and gooseberries rather less. Apples are expected to be below average, but better in the west and midlands than in the east and south; pears are generally abundant, while cherries and plums are rather below average on the whole. But with all kinds of fruit there is very considerable diversity in different parts of the country.

Prospects for hops have greatly deteriorated during the month. The rain was much needed to encourage growth of the bine, but the cold nights have counteracted this; and the heavy storms have done a good deal of damage without diminishing the blight. Hops have experienced one of the worst attacks of aphis for thirty years, which has greatly weakened the plants, in spite of continual washing. Red spider is reported also to have done damage in the south-eastern districts. On the whole, it is considered that Worcester and Hereford will not have more than half a crop, while the Kent and Sussex districts will be from 30 to 35 per cent. below average.

Pastures have been greatly improved by the rain. Keep is plentiful everywhere, with rare exceptions, and even there the grass is recovering. Live stock are consequently doing very well.

Summarising the returns, and expressing an average crop by 100, the condition of the crops on 1st August indicated probable yields which may be denoted by the following percentages:—Wheat, 99; barley, 93; oats, 92; beans, 96; peas, 95; potatoes, 100; mangolds, 98; seeds hay, 90; meadow hay, 79; hops, 64.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st August, 1915, certain diseases of animals existed in the countries specified:—

Austria (*on the 14th July*).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (*month of June*).
Anthrax, Foot-and-Mouth Disease (1,201 outbreaks), Glanders and Farcy, Swine Erysipelas, Swine Fever.

France (*for the period 4th—17th July*).
Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox.

Germany (*for the period 1st—15th July*).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (*month of June*).
Anthrax, Foot-and-Mouth Disease (186 ontbreaks), Foot-rot, Glanders, Swine Erysipelas.

Hungary (*on the 14th July*).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Italy (*for the period 12th—18th July*).
Anthrax, Blackleg, Foot-and-Mouth Disease (226 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosis.

Norway (*month of June*).
Anthrax, Blackleg, Swine Fever.

Rumania (*for the period 21st—29th June*).
Anthrax, Foot-and-Mouth Disease, Glanders and Farcy, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Russia (*month of March*).
Anthrax, Foot-and-Mouth Disease (50,278 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (month of May).
Anthrax, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (month of June).
Anthrax, Blackleg, Foot-and-Mouth Disease (3 outbreaks), Swine Fever.

Switzerland (for the period 19th—25th July).
Anthrax, Blackleg, Foot-and-Mouth Disease (26 "étables" entailing 3,712 animals, of which 7 "étables" were declared infected during the period), Glanders, Swine Fever.

No further returns have been received in respect of the following countries :—*Belgium, Bulgaria, Montenegro, Serbia.*

The Weather in England during July.

District.	Temperature.		Rainfall.				Bright Sunshine.	
	Daily Mean.	Diff. from Average.	Amount.		Diff. from Average.	No. of Days with Rain.	Daily Mean.	Diff. from Average.
	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours
Week ending July 10th:								
England, N.E. ...	58·3	—0·3	1·54	39	+27	4	5·1	—1·6
England, E.	61·7	+1·2	0·94	24	+13	4	6·1	—1·3
Midland Counties ...	58·8	—1·1	1·57	40	+28	4	4·9	—1·8
England, S.E.... ...	61·6	+0·6	0·67	17	+ 7	3	6·3	—1·4
England, N.W. ...	57·6	—1·1	0·98	25	+10	3	5·2	—1·2
England, S.W. ...	58·7	—0·7	1·12	29	+16	3	5·9	—1·1
English Channel ...	60·4	—0·2	0·42	11	0	2	9·7	+1·2
Week ending July 17th:								
England, N.E.... ...	55·5	—3·3	1·19	30	+18	5	4·9	—1·5
England, E.	57·3	—3·4	1·42	36	+23	5	4·5	—2·6
Midland Counties ...	55·9	—4·2	1·47	37	+24	4	4·6	—1·7
England, S.E.... ...	57·3	—4·2	1·30	33	+21	4	4·1	—3·3
England, N.W. ...	56·2	—2·7	0·73	19	+ 3	4	5·4	—0·8
England, S.W. ...	56·5	—3·3	1·53	39	+23	4	5·9	—0·8
English Channel ...	57·9	—3·3	1·33	34	+21	4	5·4	—2·7
Week ending July 24th:								
England, N.E. ...	58·7	0·0	0·54	14	0	4	4·8	—1·4
England, E.	59·3	—1·4	1·09	28	+13	5	5·6	—1·0
Midland Counties ...	58·3	—1·8	0·88	22	+ 7	5	4·3	—1·5
England, S.E	58·7	—2·9	1·11	28	+14	4	6·1	—0·7
England, N.W. ...	57·8	—1·2	0·61	16	— 2	4	4·7	—1·0
England, S.W. ...	57·8	—2·2	1·38	35	+16	5	5·4	—0·8
English Channel ...	59·4	—2·1	1·06	27	+13	2	8·0	+0·5
Week ending July 31st:								
England, N.E. ...	56·3	—2·4	0·42	11	— 6	4	8·1	+2·5
England, E.	58·4	—2·3	0·61	15	+ 1	4	8·0	+1·8
Midland Counties ...	56·4	—3·6	0·53	14	— 2	4	7·7	+2.2
England, S.E.... ...	58·3	—3·3	0·45	11	— 3	3	9·1	+2·7
England, N.W. ...	56·5	—2·5	0·63	16	— 4	4	8·2	+2.7
England, S.W. ...	56·8	—3·2	0·73	19	0	4	7·5	+1·6
English Channel ...	58·6	—3·0	0·69	17	+ 3	4	8·7	+1·3

* 1 inch = 25·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	JULY.		SEVEN MONTHS ENDED JULY.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	35	41	393	482
Animals attacked	50	51	451	522
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	11
Animals attacked	—	—	—	74
Glanders (including Farcy):—				
Outbreaks	7	15	32	68
Animals attacked	20	70	59	212
Parasitic Mange:—				
Outbreaks	124	123	*535	1,503
Animals attacked	271	157	*1,171	2,613
Sheep-Scab:—				
Outbreaks	3	3	159	150
Swine Fever:—				
Outbreaks	415	411	2,747	2,599
Swine Slaughtered as diseased or exposed to infection ...	1,583	4,947	12,360	27,518

* Figures for four months only, the Parasitic Mange Order of 1911 having been suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	JULY.		SEVEN MONTHS ENDED JULY.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	—	—	1	1
Animals attacked	—	—	1	1
Foot-and-Mouth Disease:—				
Outbreaks	—	1	—	76
Animals attacked	—	2	—	957
Glanders (including Farcy):—				
Outbreaks	—	—	1	—
Animals attacked	—	—	3	—
Parasitic Mange:—				
Outbreaks	8	6	44	55
Sheep-Scab:—				
Outbreaks	14	28	268	375
Swine Fever:—				
Outbreaks	22	26	162	142
Swine Slaughtered as diseased or exposed to infection ...	87	69	910	712

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in July and June, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	July. First Quality.	July. Second Quality.	June. First Quality.	June. Second Quality.
FAT STOCK:—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle:—	s. d.	s. d.	s. d.	s. d.
Polled Scots	13 4	12 4	13 6	12 5
Herefords	13 4	12 0	13 2	11 10
Shorthorns	13 2	12 1	13 1	11 11
Devons	13 4	12 0	13 2	12 0
Welsh Runts	13 3	12 7	12 11	12 3
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	10¾	9¾	10½	9¾
Sheep:—				
Downs	11	10	11	10
Longwools	10¼	9½	10¼	9¾
Cheviots	11½	10	11¾	10¾
Blackfaced	10½	9¾	11	10
Welsh	10½	9½	11	10
Cross-breds	10¾	10	11½	10½
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs:—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	9 7	9 0	9 4	8 9
Porkers	9 11	9 5	9 8	9 2
LEAN STOCK:—	per head.	per head.	per head.	per head.
Milking Cows:—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	26 6	21 10	25 12	20 18
,, —Calvers ...	24 12	20 13	24 15	20 12
Other Breeds—In Milk ...	24 3	19 9	24 1	18 19
,, —Calvers ...	18 0	16 10	18 10	17 10
Calves for Rearing	3 5	2 10	3 6	2 14
Store Cattle:—				
Shorthorns—Yearlings ...	13 9	11 5	13 15	11 15
,, —Two-year-olds...	18 9	16 2	18 7	16 2
,, —Three-year-olds	23 19	20 18	23 3	19 15
Herefords —Two-year-olds...	21 0	17 5	20 1	17 0
Devons— ,,	18 10	16 8	21 6	18 1
Welsh Runts— ,,	17 10	16 18	16 18	15 18
Store Sheep:—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	44 1	36 8	54 10	45 8
Store Pigs:—				
8 to 12 weeks old	26 11	21 1	26 3	20 7
12 to 16 weeks old	41 5	32 1	41 0	32 8

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in July, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham. s.	d.	Leeds. s.	d.	Liverpool. s.	d.	London. s.	d.	Manchester. s.	d.
		per cwt.		per cwt.		per cwt.		per cwt.		per cwt.	
BEEF:—											
English	1st	88	6	86	6	—		88	6	84	6
	2nd	84	0	83	6	—		83	6	80	6
Cow and Bull	1st	78	6	79	6	76	0	76	6	76	6
	2nd	74	0	72	6	70	6	71	6	70	0
Irish: Port Killed	1st	85	0	83	0	83	0	85	0	81	0
	2nd	81	6	78	0	78	0	80	6	76	0
Argentine Frozen—											
Hind Quarters	1st	78	0	78	0	78	0	77	6	78	0
Fore "	1st	70	0	72	6	69	0	67	0	69	0
Argentine Chilled—											
Hind Quarters	1st	82	0	79	6	81	6	81	6	81	6
Fore "	1st	69	0	67	6	69	0	67	6	68	0
Australian Frozen—											
Hind Quarters	1st	76	6	76	6	76	6	76	6	77	0
Fore "	1st	67	6	70	0	69	0	68	0	69	0
VEAL:—											
British	1st	88	6	83	0	93	6	88	0	87	0
	2nd	81	0	78	6	85	6	81	0	81	6
Foreign...	1st	—		—		—		91	6	—	
MUTTON:—											
Scotch	1st	—		—		—		91	0	88	6
	2nd	—		—		—		86	6	84	6
English...	1st	87	0	92	6	—		87	6	84	6
	2nd	78	6	88	0	—		81	0	78	6
Irish: Port Killed	1st	—		—		83	0	84	0	81	0
	2nd	—		—		77	0	79	6	76	6
Argentine Frozen	1st	67	0	65	0	65	6	66	6	65	6
Australian "	1st	64	6	63	6	63	0	64	0	63	0
New Zealand "	1st	67	6	64	0	—		69	0	—	
LAMB:—											
British	1st	89	0	98	0	88	6	95	6	92	0
	2nd	86	6	90	0	83	6	87	0	87	6
New Zealand	1st	81	6	81	6	81	0	80	6	81	0
Australian	1st	77	0	76	0	75	0	76	6	75	0
Argentine	1st	76	6	74	6	76	6	76	6	76	6
PORK:—											
British	1st	83	6	77	0	74	6	83	6	74	0
	2nd	79	6	74	0	69	6	78	6	69	0
Foreign...	1st	—		—		—		—		—	

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in July, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Bristol. First Quality.	Bristol. Second Quality.	Liverpool. First Quality.	Liverpool. Second Quality.	London. First Quality.	London. Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	16 0	15 0	—	—	16 0	15 0
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	147 6	145 0	145 6	142 6	147 0	143 0
" Factory	137 0	135 0	133 6	129 6	134 0	130 0
Danish...	—	—	161 6	159 0	160 0	156 6
French...	—	—	—	—	142 0	136 0
Russian	136 0	132 0	134 6	132 0	132 0	128 0
Australian	—	—	—	—	140 6	137 6
New Zealand	—	—	—	—	146 0	144 0
Argentine	—	—	—	—	143 6	140 6
CHEESE:—						
British—						
Cheddar	97 6	90 6	101 6	100 6	100 0	94 6
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	89 0	83 6	92 0	85 0
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	86 6	83 0	84 6	82 0	84 0	80 6
BACON:—						
Irish (Green)	98 0	95 0	94 6	89 6	96 6	92 6
Canadian (Green sides)	87 0	83 6	88 0	77 6	88 0	83 6
HAMS:—						
York (Dried or Smoked)	120 0	116 0	—	—	120 0	116 0
Irish (Dried or Smoked)	—	—	—	—	117 6	111 6
American (Green) (long cut)	74 6	71 6	74 6	71 6	75 6	73 0
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British...	14 7	13 9	—	—	15 0	14 2
Irish	13 9	13 6	13 3	12 3	13 7	13 0
Danish...	—	—	—	—	15 0	13 6
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
Early Eclipse... ...	135 0	110 0	—	—	130 0	110 0
Other First Earlies ..	145 0	96 6	126 6	95 0	126 6	106 6
British Queen ...	110 0	95 0	136 6	123 6	110 0	90 0
HAY:—						
Clover	—	—	125 0	96 0	110 6	103 6
Meadow	—	—	—	—	104 0	93 6

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	WHEAT.						BARLEY.						OATS.					
	1913.		1914.		1915.		1913.		1914.		1915.		1913.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Jan. 2 ...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
" 9 ...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
" 16 ...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
" 23 ...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
" 30 ...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6 ...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
" 13 ...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
" 20 ...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
" 27 ...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6 ...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
" 13 ...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
" 20 ...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
" 27 ...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3 ...	31	4	31	6	54	6	27	0	25	6	31	9	19	2	18	5	30	6
" 10 ...	31	3	31	5	54	9	27	8	26	8	31	3	19	2	18	4	30	4
" 17 ...	31	6	31	7	55	4	26	11	25	4	30	10	18	10	18	4	30	5
" 24 ...	31	8	31	9	56	5	26	7	26	6	31	5	19	3	18	5	30	11
May 1 ...	32	2	31	9	58	3	25	11	26	0	32	7	19	6	18	5	31	5
" 8 ...	32	6	32	2	60	5	25	9	25	6	33	3	19	6	18	9	32	4
" 15 ...	32	10	32	7	61	7	25	4	26	3	34	0	19	9	18	11	32	5
" 22 ...	32	10	33	0	62	0	25	3	25	10	34	1	19	11	19	0	32	8
" 29 ...	32	7	33	9	61	11	26	1	26	1	34	8	20	1	19	4	32	7
June 5 ...	32	10	34	0	61	9	26	2	25	11	35	4	19	8	19	4	32	5
" 12 ...	32	8	34	1	60	1	24	7	24	11	34	5	20	2	19	8	32	4
" 19 ...	32	8	34	1	56	1	23	10	25	10	34	3	19	8	19	9	31	9
" 26 ...	32	8	34	3	52	0	24	3	25	4	34	4	19	1	20	0	31	9
July 3 ...	33	1	34	4	49	5	25	2	24	6	35	3	21	0	19	9	31	1
" 10 ...	33	4	34	2	50	1	25	10	24	9	34	7	19	4	20	0	31	6
" 17 ...	33	6	34	1	52	7	24	9	24	2	35	8	20	5	19	10	31	6
" 24 ...	33	10	34	0	53	10	24	1	24	7	35	10	20	8	19	9	32	1
" 31 ...	34	1	34	2	55	3	24	5	25	9	36	1	20	3	19	8	31	1
Aug. 7 ...	34	1	34	9			24	9	25	2			19	0	19	1		
" 14 ...	34	3	40	3			24	7	29	4			18	7	25	1		
" 21 ...	33	7	38	9			26	5	29	10			18	8	24	3		
" 28 ...	32	7	36	2			29	0	30	3			17	10	23	5		
Sept. 4 ...	31	11	36	5			30	11	30	6			17	8	23	9		
" 11 ...	31	9	37	10			31	5	29	11			18	0	23	11		
" 18 ...	31	7	38	3			30	9	29	5			17	11	23	8		
" 25 ...	31	6	37	6			30	1	29	3			17	9	23	3		
Oct. 2 ...	31	3	37	1			29	9	29	1			17	10	22	9		
" 9 ...	31	0	36	8			29	1	28	10			17	10	22	5		
" 16 ...	30	11	36	7			28	8	28	8			17	9	22	4		
" 23 ...	30	7	37	2			28	7	28	7			18	0	22	5		
" 30 ...	30	1	37	10			28	2	28	3			17	9	23	7		
Nov. 6 ...	30	0	38	8			28	1	28	6			17	9	23	7		
" 13 ...	30	1	39	8			27	8	29	0			17	11	24	8		
" 20 ...	30	4	41	0			27	5	29	8			18	1	25	5		
" 27 ...	30	9	41	11			27	0	30	3			18	4	25	8		
Dec. 4 ...	31	2	42	2			26	8	30	2			18	4	25	9		
" 11 ...	31	2	42	1			26	5	29	11			18	6	25	9		
" 18 ...	31	2	42	7			25	11	29	8			18	5	25	9		
" 25 ...	31	0	43	3			25	10	29	9			18	4	25	11		

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of July, 1914 and 1915.

—	Wheat.		Barley.		Oats.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
London	34 11	54 10	24 8	36 3	20 9	32 11
Norwich	34 2	51 1	25 0	36 3	19 3	32 6
Peterborough	33 8	52 10	23 11	34 9	19 5	31 9
Lincoln	34 1	51 4	25 0	33 0	20 6	31 9
Doncaster	33 10	50 8	—	34 3	19 5	30 11
Salisbury	33 6	50 11	—	35 5	19 5	31 2

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

France, Ministère de l'Agriculture.—L'Effort Agricole de la France: Pendant Six Mois de Guerre. (Août, 1914–Janvier, 1915.) (139 pp.) Paris, 1915. [63(44).]

Woll, F. W.—Handbook for Farmers and Dairymen. [6th edition.] (490 pp.) New York: John Wiley & Sons. London: Chapman & Hall, 1914. 6*s.* 6*d.* net. [63(022); 63.70(02).]

Kershaw, G. B.—Guide to the Reports, Evidence and Appendices of the Royal Commission on Sewage Disposal. (178 pp.) London: P. S. King & Son, 1915. 5*s.* net. [628.2.]

King, F. H.—Soil Management. (311 pp.) New York: Orange Judd Co.; London: Kegan Paul & Co., 1914. [63.11(02).]

New Jersey Agricultural Experiment Station.—Bull. 267:—Comparison of Magnesian and Non-Magnesian Limestone in Rotation Experiments. (40 pp.) [63.15.] Bull. 270:—Ammonification Studies with Soil Fungi. (39 pp.) [576.83.] New Brunswick, N.J., 1914.

Cornell Agricultural Experiment Station.—Circ. 25:—Outline of the Relation of the Use of Lime to the Improvement of the Soil. (41–49 pp.) 1914. [63.15.] Bull. 338:—An Examination of Some More Productive and Some Less Productive Sections of a Field. (116 pp.) 1913. [63.113.] Ithaca, N.Y.

Ohio Agricultural Experiment Station.—Circ. 151:—Methods of Soil Sterilisation for Plant Beds and Greenhouses. (65–74 pp.) Wooster, Ohio, 1915. [63.115.]

Wisconsin Agricultural Experiment Station.—Bull. 249:—A New Test for Soil Acidity. (16 pp.) Madison, Wisc., 1915. [63.113.]

U.S. Department of Agriculture.—Bull. 213:—The Use of Land in Teaching Agriculture in Secondary Schools. (12 pp.) Washington, 1915. [373.]

Field Crops—

Lindsey County Council.—Bull. 2, 1914–15:—Report of the Trials with Varieties of Potatoes. (12 pp.) Lincoln, 1915. [63.512(04).]

Massachusetts Agricultural Experiment Station.—Bull. 161:—The Effect on a Crop of Clover of Liming the Soil; and Toxic Effect of Iron and Aluminium Salts on Clover Seedlings. (119–129 pp.) Amherst, Mass., 1915. [63.15; 63.33(b).]

U.S. Department of Agriculture.—Bull. 199:—Loss in Tonnage of Sugar Beets by Drying. (12 pp.) Washington, 1915. [63.3432.]

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 6.

SEPTEMBER, 1915.

LORD SELBORNE'S FOOD SUPPLY MEETING.

THE following address was given by THE PRESIDENT OF THE BOARD OF AGRICULTURE AND FISHERIES (THE RIGHT HONOURABLE EARL OF SELBORNE, K.G., G.C.M.G.) at a meeting with farmers and agricultural associations to consider the steps to be taken to maintain, and, if possible, increase the production of food in England and Wales, held at the House of Lords on Thursday, 26th August, 1915, at 3 p.m.

Lord SELBORNE said : My Lords and Gentlemen : I have asked you to come here to-day to hear what I have to say about the position in which agriculture in England and Wales will find itself in the coming year, which commences after this harvest. But before I speak on that subject, I think you would wish me to say something about the state of the war, and indeed it is necessary that I should do so, because it is the war conditions under which we are living which will be the governing conditions for all our farmers in the coming year.

You will have read recently a remarkable summary of the naval position, put forward by Mr. Balfour. It amounts to this, that at sea we have achieved a complete triumph, and a final triumph, if the German fleet is not prepared to come out and fling down the gage of battle. (Hear, hear.)

In all the minor land operations of the war we have been successful, except in East Africa, where we had a severe rebuff last November, and where neither side has been able since to achieve an advantage over the other. I call them minor operations only in comparison with the great operations going on in Europe, because the operations in Mesopotamia have been as important as successful ; and General Botha's triumph

in German South-West Africa has been a most remarkable achievement. (Cheers.)

Now, in Europe, we are engaged in warfare in two fields. At the Dardanelles, the physical features of the Gallipoli Peninsula present the most formidable difficulties to our Army and it has not yet been able to secure those positions which would enable it to dominate the situation. I believe that the German officers who control the Turkish army thought it impossible for our troops to effect a landing on the Peninsula at all, and the fact that they did so, both at Cape Hellas and at the Anzac Cove enables you to take some measure of their heroism and indomitable spirit. (Hear, hear.) The presence of our Army in the Peninsula has attracted to it troops from all over the Ottoman Dominions, and so we have been able to render a real service to Russia by reducing the Turkish forces which otherwise would be confronting the Russian army in the Caucasus.

Then I pass to the Western field of warfare. I need not remind you on this occasion of the historic heroism of Belgium —(hear, hear)—and I am sure you all feel, as all our men at the front feel, that no tribute can be too great to the dauntless spirit of France and to the unmatched bravery and efficiency of the French army. (Hear, hear.) But neither side has been able now for many months past to achieve a decisive success over the other. You know the causes of that delay—I need not dilate on them to-day—I can only say that immense vigour is now being shown in endeavouring to repair the omissions of the past.

And now we pass to the German successes in the East of Europe. Those successes, Gentlemen, are the successes of an efficient military organisation, not the successes of the German soldier over the Russian soldier. The Russian soldier has been absolutely sublime—(hear, hear)—under circumstances more trying to an army than, I should think, ever occurred in the history of modern warfare. You know the causes of the Russian retreat ; the same causes that are responsible for our position in the West. It is not for us to make any criticism on Russia ; nor is it wonderful, really, that the Germans should have achieved so great a triumph in this matter of organisation. We know their national characteristics of thorough work and preliminary study, but it was said long ago that the national industry of Prussia is war, and we must remember that Germany has been preparing for this war for years past—(hear, hear)—that she alone willed war when all the rest of the nations of

Europe urgently longed for peace—(hear, hear)—and that she made war at the moment chosen by her.

It is not unnatural, however, that the Germans should feel elated. They have achieved nearly half as great a success by land as we have by sea. But, Gentlemen, we have supreme confidence in all our Allies, and in our own people. (Hear, hear.) It is true that there have been omissions in the past for which we are paying dearly, but it is also true that we have redeemed all our pledges ten-fold. But I cannot conceal from you that we are still faced by a long and grim struggle. (Hear, hear.) You must remember that the set-back of Russia imposes a greater burden upon the Western Powers and so upon Great Britain; we have a greater burden on our shoulders at the present moment than we had six months ago.

Now, Gentlemen, how are our people equipped for this grim and terrible struggle? I believe that no people has ever existed which, by its temperament, was more fitted to endure and to win through. You know the heroism of our seamen and of our soldiers, but I want you also to think of the heroism and self-sacrifice of the women of England, and of the working-men of England. (Hear, hear.) The attitude of the women has been nothing but an inspiration to the men—absolute self-sacrifice, perfect calm determination to win through in this cause on which the whole future of their children and their grandchildren depends.

But what about the working-men? You read of the failures, and you discuss the failures; you read of a strike, and you condemn it; you are quite unable to understand how, at such a time as this, insistence should be laid on Trade Union rules. Gentlemen, among Trade Unionists and other working-men there are selfish and unpatriotic men, just as there are in any other class of the community, but the great majority of these labour troubles do not arise from selfishness, they arise from want of the power of imagination, from inability to understand how the action of a trade section in a particular works may affect the fortunes of this great war. But I want you not to think of the failures, but to think of the successes. You read of the failures; you read of the trouble; but you read nothing of what the millions of working-men who do not fail have been doing, and are doing. (Hear, hear.) It was only in an American paper that I happened to read the account of an ammunition factory almost entirely manned by women. One woman had worked consecutively for thirty hours, and so great was the strain in that factory that the women thought

nothing of the hours they worked. But when the day came that they had achieved a certain output of munitions, they decorated the whole factory and all their machines with flags.

Have you thought of what the railwaymen are doing? An immense number of men have been taken from the railways. The railways are carrying now a volume of trade such as never has been carried on our railways before, and the strain on those men is very great. That is nothing but silent heroism; as necessary and as great a contribution to victory as the work of the seaman or the work of the soldier.

And think of the men in the dockyards, and many other factories, who have been working seven days a week and overtime, and who fall to sleep whenever they knock off work. All that is not chronicled in the newspapers, but all that is going on, and it shows you how splendid is the temper of the country, and that you are not to judge only by those occasional troubles of which you read. (Hear, hear.) But, Gentlemen, should it not be so, for what is the stake? It is not only the existence of our Empire, or the existence of the trade by which our people live, but all our national ideals are at stake. A nation is composed of the aggregation of ideals. We all wish for a better and a happier England. One man may think that the happiness of England depends on the work of the Church, or on religious education; another may think that it really depends on the maintenance of Trade Union principles; and between those two ideals there is every possible variety of ideals; but the reason why we are united is because our ideals are all, at one and the same time, at stake in this war. Democracy itself is on trial, and all the institutions which derive their spirit from democracy are on trial. Liberty is fighting for its existence against a dominant military caste; the question at issue is whether brute force, which owns no moral law, is, or is not to be, enthroned in Europe. Those are the questions for which we are fighting, and no man, no set of men, in the whole country have their personal ideals more at stake than the Trade Unionists. I would almost put it thus—the struggle is between the British Trade Unions and the super-capitalist, Krupp, and whether the Trade Unions win or lose depends entirely upon themselves.

It is quite right that we should face squarely our own shortcomings, difficulties, dangers, and disappointments, but if we want really to understand the position we should also try and put ourselves in the place of our enemies. From the very commencement they desired that this should be a short

war; first of all it was to be a six weeks' war, then a six months' war, and now they want to end the war before the winter. They dread a prolonged war; they dread a test of endurance, and you may be sure that the sun of present victory does not really blind their eyes to the cloud of doom which looms over them in the coming year. (Hear, hear.)

I have dwelt on all this because I want to lead up to this point. The situation in which we find ourselves is going to demand from us, from every class of our community, a greater and a greater sacrifice. The financial strain on us is going to be very great indeed—(hear, hear)—and there is going to be a demand for many more men for the Army. I do not care what the system is in this respect—whether it be voluntary, or whether it be compulsory—many more men have got to go to the Army, and from agriculture among other industries.

The agricultural labourer has done his part nobly in this war. (Hear, hear.) Do not let us forget that that is no new experience for him; he has played his part in all our past wars, and in time of peace it is no exaggeration to say that a proportion of the defence of the country out of all comparison to their numbers has fallen on the agricultural labourers, especially on those drawn from the west, the south, and the east of England, both for service in the Navy and service in the Army. In this war, as I have said, the agricultural labourers have played their part nobly, but the response has been very unequal over the country. In some districts, villages and farms have been practically denuded of their young men; but in others, hardly any men have gone; and, therefore, what I forecast is going to happen in this next farming year is this—that men will be taken, and will have to go, from those districts and from those farms whence they have not hitherto gone. I hope that those farms which have nearly been denuded will not be further denuded. (Hear, hear.) At any rate, I have done, and shall do, my best to take care that no one in what I would call the most skilled class of agricultural labour is taken. (Hear, hear.) What I shall aim at is this—and Lord Kitchener has been very sympathetic whenever I have approached him on the subject—to leave you your foremen, your stockmen, your carters and your shepherds. (Hear, hear.) But, if those are left you, in many and many a place, the rest of the work will have to be done by women, or by men who have not hitherto been engaged in agriculture.

Now, those are the conditions, the war conditions, which will

govern the farmer's work in the coming year, and all that I have now to say about the work of the agricultural community n the year just commencing will be governed by those conditions.

Soon after the war broke out, my predecessor appointed an Agricultural Consultative Committee, of which Sir Ailwyn Fellowes is the Chairman. That committee is a very strong one. It has been summoned from time to time to advise the Board of Agriculture on any particular question on which advice was equired for the moment. For instance, when I have had to leal with these Live Stock Orders, on both occasions I have onsulted that committee, and I am glad to take this opporunity of expressing the gratitude of my predecessor and nyself for the great services which that committee has endered.

But I thought that something more was required, and that was advisable to appoint a Committee, with a special eference—how the food production of the country could be naintained, and, if possible, increased during the war. That s not a committee which will sit permanently during the war, ke Sir Ailwyn Fellowes' committee, but which will make its eport and then be dissolved. Lord Milner accepted the hairmanship of that committee, and again I think I may claim nat its membership was as representative and as strong as it ould be made. That committee has not yet sent in its final eport, but, in July, it sent in an Interim Report, which will hortly be published.

Now, I am going to tell you what were the recommendations n that report. It was exclusively concerned with the question f wheat growing, and in this report—subject to a governing aragraph which stated that the Government, and the Government alone, could say whether, on a given occasion, a given easure was advisable—subject to that condition it recomended that the farmers be offered a 45*s.* a quarter guarantee n wheat for four years commencing after next harvest, that to say the guarantee would begin to run after the harvest of 916 and would run till the harvest of 1920. That recommendaon was accompanied by a careful estimate, set forth on e highest authority, of what the effect of such a guarantee ight be supposed to be. It made recommendations for a achinery to set the guarantee in working order and to ensure at the conditions laid down in respect of the guarantee ould be fulfilled. The report also dealt with such important

ages of

the agricultural labourer. Now, those recommendations can only be considered in what I would call their war aspect. If those recommendations had been made before the war, they would have evoked great party controversy, and we should all have had our own opinion about them ; and the same will be true, though in a wholly different sense, after the war. I have no hesitation in expressing my personal opinion that, after the war, the whole of the question of our agricultural and economic policy and of food production at home will have to be revised—(hear, hear)—in the light of our experience of submarine warfare. At present, the Navy have the submarine menace well in hand, in that there is no reason so far to fear that the Germans will be able to effect a complete interruption of our sea communications during the course of this war, though periodically they may be seriously disturbed. They were very disturbed last week ; they may be more disturbed in the future. But, after the war, we have got to consider what the developments of submarine navigation and submarine construction may be, and unless some naval answer to the submarine is forthcoming, which has not yet been forthcoming, I again express my personal opinion that we shall have to revise and review our agricultural and economic position in the light of our experience.

But the question is no more of the future than it is of the past. The question is simply and solely a war question :—Is this or is this not a wise guarantee to give at the present time, in view of the great importance of increasing our home production of all sorts, but not least of food, in view of the financial position, in view of the drain of men for the Army, and of other matters.

After this report had been received I need not say that the Admiralty were consulted, and that all through the Government have acted in consultation with them, and what is of great importance as bearing on this question was fresh information which reached them after that report had been received, and before it had been considered. Shortly after it had been received, the Agricultural Returns of 1915 came to hand, first of all 75 per cent. of them, then 90 per cent. of them, and the final figures I hope will be ready for publication in a few days. In addition to that we had the final reports on the Canadian and Australian harvests. The figures I am going to give you about the Agricultural Returns are for the year 1915, compared with the year 1913. I take 1913, because that, you will find in the Interim Report of Lord Milner's committee, was the year taken by them as the standard for

comparison. The figures of increase would not be so great if the comparison were with the year 1914, because the upward tendency had already then commenced, but as compared with the year 1913 there are at the present moment 500,000 more acres of wheat under cultivation, or an increase of nearly 30 per cent. The increase in cattle is 384,000, and the increase in sheep 450,000. There is very little importance to be attached to the figures of the increase of sheep, because, as you know, we reached a very low point two or three years ago, and this is only a partial recovery, but the figures for cattle constitute an absolute record. In view of these remarkable figures disclosed by the Agricultural Returns; in view of the fact that it was borne in upon us as the history of the struggle in the East of Europe developed that the call on men, on agricultural labourers, for the colours would be very heavy in the coming year; in view of the difficulties with which the farmer would thereby be confronted; in view of the superabundant harvest in Canada and Australia, and in view of the great financial stringency which will certainly prevail after the war, the Government decided that they would not incur the additional financial liability involved in the guarantee.

I know that that decision will disappoint many of my agricultural friends. I am quite prepared for, and shall make no complaint of, criticism. I only have this one observation to make, and that is, that, in taking our decisions of war policy from day to day, we have to balance against each other a great number of complicated considerations that are often conflicting, and all that can be done is to take that decision to which the balance of argument seems to incline.

I have stated the grounds on which this decision has been arrived at, and if you want to criticise it fairly you must consider all that I have put before you—the increase in wheat acreage and in the number of cattle, the great drain that is going to be made on the manhood of the country, the great financial stringency which will prevail after the war—and balance those, as we did, against the manifest and clear advantage otherwise of doing all we could to stimulate the production of wheat in the country.

I am very grateful to Lord Milner's Committee. If it had not been for the Interim Report of that Committee we should not have had the material on which to form a reasoned judgment. I know that immense labour and pains were taken with this Report, but I hope the Committee will not cease its labours because, for the reasons I have given, we came to

the conclusion that we could not adopt that particular recommendation. In carrying out the efforts I am now going to describe, their advice and assistance will be of great value, for the farmers will require all the assistance which the Board of Agriculture can give them to overcome their difficulties in the coming year; and not only the farmers, but all that part of the agricultural community which lives in villages and country towns and whose aggregated labour and effort may make such a large contribution to our total national production, if well directed, assisted and advised.

Again, I venture to say this to the farmer, that we shall have to help each other during the coming year more than ever has been necessary in past years with our machinery, and with our labour.

Now, how do I see the situation? I see that the farmer is going to have great difficulties about labour; and the farmer is not very ready, as a rule, to turn to new sources of labour. There has been a great number of women willing to volunteer their services, but very few farmers have availed themselves of their services. There has been a considerable amount of volunteer labour offered, but again, many farmers have not availed themselves of those volunteers. I think I shall be able to show from the example of farmers who have used women unskilled volunteer labour during the past few weeks that a great deal can be done through such means under the direction of the farmer himself.

Then again, the farmer has not been accustomed to make use of the Labour Exchange. The Labour Exchange has been outside his sphere of operations, and although the Labour Exchange has been very anxious to help him there has been no customary contact between the Labour Exchange and the farmer. Again, Lord Kitchener, under certain restrictions, was willing to put military labour at the disposal of the farmer, and that military labour has been used to a very considerable extent, though in varying degrees, in different parts of the country. I do not think anything like as much use has been made of that labour as might have been, nor was there any machinery, before the matter was settled by the War Office—and to this point I will come presently—to enable the farmers to offer their criticism of the conditions under which the War Office was prepared to lend the services of the soldier. Therefore, while the farmer will have great difficulty in the matter of labour, there are various sources from which labour can be drawn. The question is, can the farmer use that labour to his advantage and will he do so?

Then, again, there is the matter of requisitions. The War Office buyers come to the farmer and demand his hay at a certain price. We have taken all the precautions we could to give the farmer an opportunity of appeal. I think the machinery for that appeal is adequate ; it was published in all the newspapers ; but a large number of farmers have remained in complete ignorance of the remedy which lay to their hands, and they have suffered in silence at the time, nursed their grievance, and complained when too late. Again, in the coming year the farmers may have difficulties in the matter of supply, machinery, feeding-stuffs and fertilisers. I cannot foresee to what extent those things may present difficulties to them, but, in my judgment, in many cases there will be difficulty. Again, from time to time, the Board of Agriculture will issue Live Stock Orders. It is very difficult for the Board of Agriculture to ascertain where the shoe pinches. You may get one group of farmers protesting and stating their case reasonably and fully, and showing where they want amendment, but if you get no kind of guidance from the rest of the country it is very difficult to tell how far the case of those farmers is isolated and how far the remainder of the agricultural community is in agreement with them.

The Board of Agriculture has been assisted not only by great permanent agricultural bodies like the Royal Agricultural Society, the Associated Chambers of Agriculture and others, but also by local committees which have been established in various counties to deal with one aspect or other of the agricultural problem, and I am grateful indeed to those bodies and to those committees for the assistance they have given us in the past year, as I am also to the Labour Exchanges for doing their best to help us, though, as I have said, there was not any real contact between them and the farming community.

But what I have felt is that there is need for much better co-ordination and organisation. Here you have in London the Board of Agriculture and Fisheries, which may be able to give considerable assistance, and is anxious to devote the whole of its services to the farming community in the coming year, but which has no machinery to get into contact with the individual farmer ; and such bodies as I have described have either not been constituted for the purpose of acting as the link between the Board of Agriculture and the farmers, or, if they have so been constituted they have no staff to act in any sense in an executive manner.

Therefore I propose to adopt a valuable recommendation,

made in the Interim Report of Lord Milner's Committee, that the county council should be asked to act as the link between the Board of Agriculture and the farmer. I have not yet had the opportunity of meeting the representatives of the county councils, I hope to do so shortly, and, therefore, I have no right to speak for them, but I have very little doubt that they will do all that they possibly can to help the farmers in this emergency. (Hear, hear.) What I am going to ask them to do is to establish in each county a sub-committee, or one of their committees, if there is such a committee adapted for the purpose, to deal with the whole county, and then to appoint in the smaller areas of the county committees which will be in continuous correspondence with it. It will be for them to decide whether they would take a rural district council unit or a petty sessional divisional unit or some other unit, but I care not what it is so long as they are able to cover the whole county and to get into communication with all the farmers of the county.

When I meet the representatives of the county councils I will try and work out the details with them; therefore, all I am doing now is to give you the most general possible sketch of the machinery which I propose to adopt. I know very well from my own experience that the county councils are over-worked bodies—(hear, hear)—and that under ordinary circumstances they would be extremely loth to take upon themselves any fresh duty, but I would submit to them that the present occasion is exceptional. What I ask them to do is a patriotic duty, and there is really no other body in existence which can fill the gap. The Treasury are prepared to grant a subvention towards any expenditure to which they may be put. I do not think that the expenditure for machinery ought to be a large one. There will be a certain amount of clerical labour, printing, stationery, travelling expenses and so forth, but, as we all know, all the main part of the work will be done by voluntary labour by people who live in the county, and the actual expenditure on machinery ought not to be large.

Now how do I think that such a body would be able to work? The Board of Agriculture will for the first time be in contact with the individual farmer. The individual farmer will have a local body, not a distant body but a local body, composed of people who are his personal friends and neighbours, to which he can go with his difficulties, be they about labour, be they about military requisitions, be they about Live Stock Orders, or be they about his supplies of machinery, fertilisers and feeding-stuffs. The

county councils will advise and direct the smaller committee. The county council will be able to focus the difficulties of the farmers, to classify them, very often by advice and assistance to remove them, and where they cannot do so then they can come to the Board of Agriculture. The Board of Agriculture will have a definite responsible body to deal with in each county, instead of vainly and fruitlessly endeavouring to correspond with the individual farmer. And the officers of the Board of Agriculture, few in number and very hard-working and efficient, who are scattered throughout the country, will, of course, do all they possibly can to act also as links between the different farming communities and the county council and the Board of Agriculture.

It may be—I cannot foresee—that, as we gain experience through the county councils, there will be certain clear indications of where the Government can give material assistance to the farmers in their difficulties. All I can say about that is this: if a case is made out I shall do my best to press it. I can make no promise about financial assistance, much as I may desire it, because, as you will see, everything must be governed in this war by the financial stringency which is going to bear down upon us in the form of taxation. The first claim upon the Exchequer must be for the Army and for the Navy. (Hear, hear.)

Now, Gentlemen, I have nearly done. I have not concealed from you that I think the position of the farmer in the coming year is going to be a very difficult one. I thought it much better to tell the farmer frankly what was going to be the call on the agricultural labourers, and not to conceal it from him. (Hear, hear.)

Gentlemen, I think the record of the farmers in the year that is now closing has been a very fine one. The difficulties will be greater in the coming year, but they have been great enough in this year, and that in this year the farmers have been able to add 500,000 acres of wheat-land and to keep their stocks up to the pitch which I have described is, I think, a wonderful record.

But there are rivals to the British farmer. If you talk to people who have paid a visit to the fighting line in Flanders and France, I am quite sure every single one of them will tell you the thing that has struck him most has been the state of the cultivation of the land right up to and within the zone of fire—(hear, hear)—a cultivation which has never been surpassed in the history of France or Belgium, a cultivation

carried on by old men, by women and by children. When I was there I never saw an able-bodied man in the fields.

Now, surely what has been done in France and Belgium can be done in England and Wales. Even with these unforeseen difficulties, with these increasing difficulties, I appeal to the farmer to do even better in the coming year than he has done in the past year.

When the history of this war is written, let us look back with amazement on the fact that in the year of absolutely unparalleled difficulty the British farmer not only maintained, but increased his production of food.

But you must be willing to welcome the assistance of those whose assistance you have not been accustomed to use. After all, it is better to get in the harvest with unskilled labour than not to get it in at all—(laughter)—and if we all endeavour to help each other, to utilise all the sources of assistance which our ingenuity can find, I believe that the task which I have asked you to perform can be performed. All I can say is, the whole services of the Board of Agriculture and Fisheries and of the skilled and zealous staff over which I have the honour to preside will be at your disposal. (Cheers.)

Captain CHARLES BATHURST, M.P., Chairman of the Central Chamber of Agriculture, then replied to Lord Selborne's speech:

In joining with the PRESIDENT in expressing the greatest admiration of the magnificent pluck and patriotism of fellow agriculturists in France and Belgium, he said he was deeply conscious that, if agricultural operations could be carried on under such difficult circumstances as face them, it is the duty of English farmers to conduct their agricultural processes with the greatest amount of courage, with the greatest possible amount of patriotism, and, if necessary, at the cost of considerable personal self-sacrifice. (Hear, hear.) In referring to the shortage of labour he said that it was impossible altogether to replace skilled labour by such forms of labour as those to which the PRESIDENT alluded, and he made a special appeal to the PRESIDENT to allow the retention on the farms, if possible, of the carters, stock-men, thatchers, engine drivers, blacksmiths, and those who have skilled knowledge in the process of steam cultivation. He pleaded that it had not come clearly to the consciousness of the skilled farm hands that they were, in their present position, doing the maximum possible amount of patriotic work that could fall to their lot, and he asked the Government to make it clear to these men that they were doing their country's work more

competently in the position they now occupied than they would be likely to do in some other capacity. He pointed out that if the PRESIDENT'S appeal was to be regarded as one for a great extension of arable cultivation, involving the ploughing up of a large acreage of second-rate pasture, it would undoubtedly involve risking a large additional amount of capital which might conceivably be lost, and many agriculturists would undoubtedly have supported the report of Lord Milner's Committee in asking that they might be secured against the possible loss of this additional capital consequent upon the conversion of so-called grass land, which involves a comparatively small amount of capital to farm, into arable land, which involves a much larger outlay.

Continuing, however, Captain BATHURST stated that he pressed none of the foregoing points on the PRESIDENT'S attention, as a definite reply could not be given to the PRESIDENT'S proposals; before giving a final answer it was desirable to consult the members of all the leading agricultural organisations of the country. But what he did want to tell Lord SELBORNE was that any proposals he made now or hereafter to agriculturists would not only receive their utmost possible sympathy, but whatever be the risks, whatever be the personal self-sacrifice, according to their resources—which were none too large in many cases—and according to their opportunities, they would do their utmost to support the PRESIDENT and the Government in this matter. (Hear, hear.)

In conclusion, Captain BATHURST pointed out that unless the county councils were given very full powers in acting as agents for the Board of Agriculture it might be a little difficult for them to afford speedily and effectually that assistance which the PRESIDENT stated would be forthcoming for the promotion of agricultural processes, and to carry out what agriculturists would deem to be their national duty in a year which is bound to be full of difficulties to the agricultural population. He desired absolutely to repudiate any suggestion made with regard to the selfishness of the agricultural community, or as to any inclination whatever on their part to make money at the expense of the public at a time of national crisis; and he emphasised the point that there were no more patriotic men in this country upon whom the Government were entitled to depend than the British farmers. (Cheers.)

Lord NORTHBROOK, on behalf of the representatives of agricultural societies and other bodies, in moving a vote of thanks, again assured the PRESIDENT that the farmers of this country would consider the proposals in a patriotic spirit;

they would not look on them from the point of view of their pockets or profits, but of how they could support the Government and help the country in the present great crisis.

The vote of thanks was seconded by Mr. COLIN CAMPBELL, representing the National Farmers' Union, who followed the two previous speakers in stating that the farmers would help the Government loyally in every way they could.

The resolution was put to the meeting by Captain BATHURST and carried unanimously.

The PRESIDENT then replied as follows: Captain Bathurst, Lord Northbrook, Mr. Colin Campbell and Gentlemen, I am greatly obliged to you for coming here to-day, and for what has been said, and for your vote of thanks. I am not going to make another speech. I do wish, however, to make three sets of observations in answer to what has been said, and I should be glad if the Press would be good enough to take them down, because I think they have their importance.

The first is that it is absolutely true that the agricultural community is second to none in England and Wales in patriotism. It is not true that the farmers have tried to exploit the war to their advantage (hear, hear) because the prices which rule are not prices fixed by them, but world prices. (Hear, hear.)

The second observation I wish to make is this—and it is made to every individual farmer in the country—the circumstances of no two farms or farmers are the same. I know the conditions vary everywhere. I have told you exactly and frankly the public conditions under which you will have to work in the coming year, and I appeal to you, not as a philanthropist, but as a man of business who is also a patriot. Each man can settle for himself how he can blend these two qualifications into the greatest service both to himself and to the State.

The third observation I wish to make is this, and if the Press will be good enough to report it, you can have it printed and circulated. I say to the highest skilled men in agriculture, the foremen, the stock-men, the carters, the shepherds, the engine drivers, the thatchers and the blacksmiths, if you leave your present post to go into the Army or Navy, or into a munition factory, your motives may be good, but your judgment is wholly bad—(cheers)—you can perform a greater service to England to-day by staying where you are than by going anywhere else.

The Meeting then terminated.

FARMING AND FOOD SUPPLIES IN TIME OF WAR.

R. H. REW, C.B.,

Assistant-Secretary to the Board of Agriculture and Fisheries.

THE following was Mr. Rew's Presidential Address to the Agricultural Section of the British Association, at the meeting held at Manchester from 7th-11th September, 1915 :—

Agriculture is the antithesis of warfare ; farming is pre-eminently a peaceful avocation, and farmers are essentially men of peace. The husbandman is not easily disturbed by war's alarms, and his intimate association with the placid and inevitable processes of Nature engenders a calmness of spirit which is unshaken by catastrophe. Many stories illustrative of this attitude of mind come to us from the battle-fields. The complete detachment of the fighting men from the rest of the community which was usual up to quite recent times is impossible in these days when, in almost every country, the army is not a class but the nation. It is inconceivable now that a war could rage of which it could be said, as has been said of our Civil War : " Excepting those who were directly engaged in the struggle, men seemed to follow their ordinary business and their accustomed pursuits. The story that a crowd of country gentlemen followed the hounds across Marston Moor, between the two armies drawn up in hostile array, may not be true ; but it illustrates the temper of a large proportion of the inhabitants."* But while farmers and peasants within the range of the guns cannot now ignore the fighting, they have repeatedly demonstrated their invincible determination that the madness of mankind shall not interrupt the calm sanity of the ordered cultivation of the soil. Of a district in the Argonne, a correspondent, writing in April last, said: "The spring seed has already been sown or is being sown, sometimes indifferently, under shell-fire, right up to the edge of the trenches."† A story was told of a farmer in Flanders looking over the parapet of a trench and demanding of an indignant British officer whether any of his men had stolen his pig. On receiving a suitable reply he observed that he had already asked the French, who also denied all knowledge of the missing animal, so that he supposed it must be those condemned Germans whom he forthwith proceeded to inter-

* Prothero : "English Farming, Past and Present," p. 104.

† *Westminster Gazette*, 30th April, 1915.

view. Such a sublime sense of values, such absorption in the things that matter, such contempt for the senseless proceedings of warfare are only possible to the agriculturist. The quarrels of mankind are transient, the processes of Nature are eternal. One thinks of Matthew Arnold's lines—

The East bow'd low before the blast
In patient, deep disdain,
She let the legions thunder past
And plunged in thought again.

But while the farmer is, by instinct, a pacifist, he is also, in a cause which rouses him, a doughty fighter. In that same Civil War, to which so many were indifferent, the farmers of East Anglia, under Cromwell, changed the course of English history; and the thoroughness with which they turned their ploughshares into swords is demonstrated by the fact that when they took to soldiering they put the nation, for the first and only time, under what is now termed militarism, that is, government controlled by the army. In the last battle fought on English soil the yeomen and peasants of the West country proved, amid the butchery of Sedgemoor, that bucolic lethargy can be roused to desperate courage. Indeed, through all our island story, since the English yeomen first broke the power of mediæval chivalry and established the supremacy of infantry in modern warfare, it has been from the rural districts that the nation has drawn its military strength. Even in the present war, when the armies of the Empire have been drawn from all classes of the community, the old county regiments and the yeomanry squadrons with their roots in the countryside have proved once more that the peaceful rustic is as undismayed on the field of battle as on the fields of peace.

It is, however, in his pacific rather than in his belligerent aspect that the British farmer now claims our attention; and before considering the position of farming in the present war we may briefly glance at its position when, a century ago, the nation was similarly engaged in a vital struggle.

From February, 1793 until 1815, with two brief intervals, we were at war, and the conflict embraced not only practically all Europe but America as well. The latter half of the 18th century had witnessed a revolution of British agriculture. The work of Jethro Tull, "Turnip" Townshend, Robert Bakewell, and their disciples, had established the principles of modern farming. Coke, of Holkham, had begun his missionary work; Arthur Young was preaching the gospel of progress; and in 1803 Humphrey Davy delivered his epoch-making

lectures on agricultural chemistry. Common-field cultivation, with all its hindrances to progress, was rapidly being extinguished, accelerated by the General Inclosure Act of 1801. A general idea of the state of agriculture may be obtained from the estimates made by W. T. Comber of the area in England and Wales under different crops in 1808. There were then no official returns, which indeed were not started until 1866; but these estimates have been generally accepted as approximately accurate, and are, at any rate, the nearest approach we have to definite information.

I give, for comparison, the figures from the agricultural returns of 1914 which approximately correspond to those of the earlier date :—

—	1808.	1914.
	Acres.	*Acres.*
Wheat	3,160,000	1,807,498
Barley and rye	861,000	1,558,670
Oats and beans	2,872,000	2,223,642
Clover, rye-grass, etc.	1,149,000	2,558,735
Roots and cabbages cultivated by the plough	1,150,000	2,077,487
Fallow	2,297,000	340,737
Hop grounds	36,000	36,661
Land depastured by cattle	17,479,000	16,115,750

The returns in 1914 comprise a larger variety of crops than were cultivated in 1808. Potatoes, for instance, were then only just beginning to be grown as a field crop, and I have included them, together with kohl-rabi and rape, among "roots and cabbages."

The population of England and Wales in 1801 was 8,892,536, so that there were 35½ acres under wheat for every 100 inhabitants. In 1914 the population was 37,302,983, and for every 100 inhabitants there were 5 acres under wheat.

The yield of wheat during the 20 years ending 1795 was estimated at 3 qr. per acre;* in 1914 it was 4 qr. per acre. The quantity of home-grown wheat per head of population was, therefore, 8½ bush. in 1808, and 1½ bush. in 1914. Nevertheless, even at that time the country was not self-supporting in breadstuffs. In 1810 1,305,000 qr. of wheat and 473,000 cwt. of flour were imported. The average annual imports of wheat, from 1801 to 1810, were 601,000 qr., and from 1811 to 1820 458,000 qr. Up to the last decade of the 18th century England

* Report of Select Committee on the means of promoting the cultivation and improvement of the waste, uninclosed and unproductive lands of the Kingdom, 1795.

was an exporting rather than an importing country, and bounties on exports were offered when prices were low, from 1689 to 1814, though none were in fact paid after 1792.

During the war period we are considering, the annual average price of wheat ranged from 49*s*. 3*d*. per qr. in 1793 to 126*s*. 6*d*. per qr. in 1812, the real price in the latter year, owing to the depreciation of the currency, being not more than 100*s*. In 1814 the nominal price was 74*s*. 4*d*. and the real price not more than 54*s*. per qr.* The extent to which these high and widely varying prices were affected by the European War has been the subject of controversy. As we mainly depended on the Continent for any addition to our own resources, the diminished production during the earlier years in the Netherlands, Germany and Italy, and in the later years of the war in Russia, Poland, Prussia, Saxony and the Peninsula, reduced possible supplies. At the same time the rates of freight and insurance, especially in the later years of the war, increased very considerably. Tooke mentions a freight of £30 per ton on hemp from St. Petersburg in 1809. On the other hand, a powerful impetus was given to home production, which was stimulated by Government action and private enterprise. Inclosure was encouraged by the General Inclosure Act of 1801, and 1,934 Inclosure Acts were passed from 1793 to 1815. The schemes for increasing and conserving food supplies were various. The Board of Agriculture, for example, offered prizes of 50, 30, and 20 guineas, respectively, to the persons who in the spring of 1805 cultivated the greatest number of acres—not less than 20—of spring wheat.† In 1795 a Select Committee recommended that bounties should be granted to encourage the cultivation of potatoes on "lands at present lying waste, uncultivated or unproductive," and that means should at once be adopted to add at least 150,000, and perhaps 300,000 acres, to the land under cultivation "as the only effectual means of preventing that importation of corn, and disadvantages therefrom, by which this country has already so deeply suffered." Another view of importation is presented by Tooke, who, in a discussion of the effect of the war, says: "Although the war cannot have been said to have operated upon the supply of agricultural produce of our own growth and other native commodities, sufficiently to outweigh the circumstances favourable to reproduction, it operated most powerfully in increasing the cost of production and in obstructing the supply of such

* "Porter's Progress of the Nation," by F. W. Hirst, p. 183.

† Annals of Agriculture, 1805.

commodities as we stood in need of from abroad. It is, therefore, to war chiefly as affecting the cost of production and diminishing the supply, by obstructions to importation, at a time when by a succession of unfavourable seasons our own produce became inadequate to the average consumption, that any considerable proportion of the range of high prices is to be attributed."*

The main cause of high prices and scarcity was the failure of the harvests. Mr. Prothero thus analyses the wheat harvests of the 22 years, 1793-1814—"Fourteen were deficient; in seven out of the fourteen the crops failed to a remarkable extent, namely in 1795, 1799, 1800, 1809, 1810, 1811, 1812. Six produced an average yield. Only two, 1796 and 1813, were abundant; but the latter was long regarded as the best within living memory."†

It appears paradoxical, but in a sense it is true, to say that the scarcity of wheat in certain years arose from the fact that the country was too largely dependent on its own crop. The risk of a bad harvest in a climate such as that of the British Isles must always be serious, and by the fortune of war the risk between 1793 and 1814 turned out to be very high. When supplies are drawn from the four quarters of the globe it is evident that the risk of a shortage is greatly reduced. Whether in a great war it is preferable to be more dependent on the sea than on the season is debatable.

In comparison with wars for national existence such as that against Napoleon, and in a still sterner sense that in which we are now engaged, other conflicts appear insignificant. The Crimean war, however, did affect our food supplies, and had a reflex action on British agriculture. The cessation of imports from Russia caused a rise in the price of corn. The average price of wheat rose to 72*s.* 5*d.* per qr. in 1854, 74*s.* 8*d.* in 1855 and 69*s.* 2*d.* in 1856. Only once before (in 1839) during the previous 35 years had it risen above 70*s.* There were then no agricultural returns, but the estimates of Lawes, which were generally accepted, put the area under wheat at a little more than 4,000,000 acres, a higher figure than has been suggested for any other period. It is, indeed, highly probable that the Crimean war marked the maximum of wheat cultivation in this country. It was a time of great agricultural activity and of rapid progress. To their astonishment farmers had found, after an interval of panic, that the Repeal of the

* "History of Prices," Ed. 1838, Vol. I., p. 116.

† "English Farming, Past and Present," p. 269.

Corn Laws had not obliterated British agriculture, and that even the price of wheat was not invariably lower than it had often been before 1846. Caird had preached "High Farming" in 1848 and found many disciples, capital was poured into the land, and the high prices of the Crimean period stimulated enterprise and restored confidence in agriculture.

To generalise very roughly it may be said that, while the Napoleonic wars were followed by the deepest depression in agriculture, the Crimean war was followed by a heyday of agricultural prosperity which lasted for over twenty years. What the agricultural sequel to the present war may be I leave others to estimate, and I turn to consider briefly some of its effects on British farming up to the present time.

Harvest had just begun when war broke out on the 4th of August; indeed, in the earlier districts a good deal of corn was already cut. The harvest of 1914 was, in fact, with the exception of that of 1911, the earliest of recent years, as it was also one of the most quickly gathered. The agricultural situation may, perhaps, be concisely shown by giving the returns of the crops then in hand, *i.e.*, in course of gathering or in the ground, with the numbers of live stock as returned on farms in the previous June. The figures are for the United Kingdom, and I add the average for the preceding ten years for comparison:—

	1914.	Average, 1904-13.
	qr.	*qr.*
Wheat	7,804,000	7,094,000
Barley	8,066,000	7,965,000
Oats	20,664,000	21,564,000
Beans	1,120,000	1,059,000
Peas	374,000	525,000
	Tons.	*Tons.*
Potatoes	7,476,000	6,592,000
Turnips and Swedes	24,196,000	26,901,000
Mangolds	9,522,000	9,934,000
Hay	12,403,000	14,148,000
	Cwt.	*Cwt.*
Hops	507,000	354,000
	No.	*No.*
Cattle	12,185,000	11,756,000
Sheep	27,964,000	29,882,000
Pigs	3,953,000	3,805,000
Horses	1,851,000	2,059,000

Farmers had thus rather more than their usual supplies of nearly every crop, the chief deficiencies being in peas, roots

and hay. The shortage of the hay crop was, however, in some measure made up by the large stocks left from the unusually heavy crop of 1913. It was fortunate, from the food supply point of view, that two of the most plentiful crops were wheat and potatoes. The head of cattle was very satisfactory, being the largest on record, and pigs were well above average. Sheep, always apt to fluctuate in numbers, were much below average, the total being the smallest since 1882, with the exception of 1913.

On the whole, it was a good year agriculturally, and the supply of home-grown produce at the beginning of the war was bountiful. Nature, at any rate, had provided for us more generously than we had a right to expect.

At first it appeared as if farmers were likely to be sufferers rather than gainers by the war. Prices of feeding-stuffs, especially linseed and cotton cakes, maize meal, rice meal and barley meal, rose at once, recruiting affected the labour supply, and difficulties arose in the distribution of produce by rail. With one or two exceptions, such as oats, the prices of farm produce showed but little rise for three or four months after the war began. Wheat rose about 10 per cent., barley remained about normal, cattle by November had not risen more than 3 per cent., sheep and veal calves showed no rise until December, while poultry was actually cheaper than usual, though eggs rose considerably. Butter rose slightly, and cheese remained about normal. Up to nearly the end of the year, in fact, it may be said, generally, that British farm produce made very little more money than usual.

Meanwhile the nation began to take a keen interest in the agricultural resources of the country, and farming became the object of general solicitude. We started with great energy to improvise, in truly British fashion, the means of facing the supreme crisis of our fate, but the elementary fact at once became obvious that it is impossible to improvise food produce. The main farm crops take an unreasonably long time to grow, even if the land is prepared for them, and a sudden extension of the area under cultivation is not a simple proposition. It was freely pointed out—with undeniable truth—that our agricultural system had not been arranged to meet the conditions of a great European war, and many suggestions were made to meet the emergency. Some of these suggestions involved intervention by legislative or administrative action. It was decided that any attempt violently to divert the course of farming from its normal channels would probably not result

in an increased total production from the land. The Agricultural Consultative Committee, appointed by the President of the Board of Agriculture on the 10th of August, issued some excellent advice to farmers as to their general line of policy and the best means by which they could serve the nation, and this was supplemented by the Board and by the agricultural colleges and local organisations throughout the country. More than 30 Special Leaflets have been issued by the Board, but while it may, I think, fairly be claimed that all the recommendations made officially were sound and reasonable, I should be the last to aver that farmers were universally guided by them. They do not accept official action effusively—

> "*Unkempt about those hedges blows*
> *An English unofficial rose*"—

and official plants do not flourish in farm hedgerows. It was, however, fairly evident that patriotism would suggest an effort to obtain the maximum production from the land, and there were good reasons to think that self-interest would indicate the same course. It must be admitted, however, that during the autumn the lure of self-interest was not very apparent. Food prices, however, at the end of the year began to rise rapidly. English wheat in December was 25 per cent. above the July level, in January 45 per cent., in February and March 60 per cent., and in May 80 per cent. Imported wheat generally rose to a still greater extent, prices in May standing, for No. 2 North Manitoba 95 per cent., and No. 2 Hard Winter 90 per cent., above July level.

The greater rise in imported wheat may be noted as vindicating farmers in respect of the charge which was made against them of unreasonably withholding their wheat from the market. Cattle and sheep rose more slowly, but in March prices of both had risen by 20 per cent., and in May and June cattle had risen by about 40 per cent. Butter rose by about 20 per cent. and cheese by about 40 per cent. Milk rose little through the winter, but when summer contracts were made prices remained generally at the winter level.

British agriculture, like the British Isles, is a comparatively small affair geographically. The 47 million acres which it occupies, compared with the 80 million acres of Germany or the 90 million acres of France, and still more with the 290 million acres of the United States, represent an area which may be termed manageable and about which one might expect to generalise without much difficulty. But, in fact, generalisation is impossible. Even on the 27 million acres of farm land

in England and Wales there is probably more diversity to the square mile than in any country on earth. The variations in local conditions, class of farming and status of occupier, preclude the possibility of making any general statement without elaborate qualifications. Thus, whatever one might say as to the effects of the war on agriculture would be certain to be inaccurate in some districts and as regards some farmers.

There are three main agricultural groups: corn-growing, grazing and dairying. They overlap and intermingle indefinitely, and there are other important groups, such as fruit-growing, vegetable-growing, hop-growing, etc., which represent a very large share of the enterprise and capital engaged on the land. The receipts of the corn-growing farmer, generally speaking, were substantially increased. Probably about 50 per cent. of the wheat crop had been sold before prices rose above 40*s*. per quarter, and there was very little left on the farms when prices reached their maximum in May. Oats rose rather more quickly, but did not reach so high a level, relatively, as wheat. Barley—owing perhaps to enforced and voluntary temperance—never made exceptional prices, and, in fact, the best malting barleys were rather less than average value. There is no doubt, however, that farmers who depended mainly on corn-growing found an exceptionally good market for their crops and made substantial profits. Farmers who depended mainly on stock were generally less fortunate, although stock were at a fairly high level of price when the war began. Sheep for some time showed no signs of getting dearer, but in the spring prices rose substantially, and a good demand for wool—which in one or two cases touched 2*s*. per lb.—made the flockmasters' returns, on the whole, very satisfactory. Cattle followed much the same course; stores were dear, but by the time fat stock came out of the yards or off the grass prices had risen to a very remunerative level. The large demands on imported supplies of meat for the British and French armies occasioned a distinct shortage for the civil population, but this was relieved by a reduced demand, so that the effect upon prices of native beef and mutton was not so great as might have been expected. The influence of a rise of price upon demand is more marked in the case of meat than in that of bread. While there has been a distinct reduction in the consumption of meat there is no evidence of a reduced consumption of bread.

Dairy farmers generally found themselves in difficulties. Prices of butter and cheese increased but slightly, and milk

remained for a considerable period almost unchanged. The rise in the prices of feeding-stuffs and the loss of milkers aggravated their troubles. An actual instance of the position in February as affecting a fairly typical 200-acre farm may be quoted. It had 30 milch cows producing about 16,500 gal. per annum. The cake bill showed an advance of 50 per cent., and wages had risen 12 per cent. It was calculated that the extra cost was 1·3*d.* per gal. of milk. Later the prices of milk, butter and cheese rose, but, on the whole, it cannot be said that dairy farmers generally made exceptional profits.

While it is certain that the gross receipts by farmers were substantially increased, it is very difficult to estimate what the net pecuniary gain to agriculture has been. It can only be said, generally, that while some have made substantial profits, which were probably in very few cases excessive, many others have on balance (after allowing for extra cost) done no better financially, and some, perhaps, even worse, than in an average year of peace. With regard to one item of extra cost, that of labour, it is possible to make an approximate estimate. Agricultural labourers were among the first to respond to the call for the new armies, and, up to the end of January, 15 per cent. had joined the forces of the Crown. This considerable depletion of labour was not acutely felt by farmers during the winter, but during the spring and summer serious difficulty was experienced and many devices were suggested—some of which were adopted—for meeting it. Naturally the wages of those agricultural labourers who were left rose, the rise varying in different districts, but being generally from 1*s.* 6*d.* to 3*s.* per week. Owing to the rise in the price of commodities this increase of wages cannot be regarded as a profit to the labourers, but it is, of course, an outlay by farmers which in England and Wales may be reckoned as amounting to an aggregate of about £2,000,000.

This country has never suffered from a dearth of agricultural advisers, and, in such a time as the present, when everyone is anxious to help the country, it is natural that they should be unusually plentiful. Advice was freely offered both to the Government how to deal with farmers and to farmers how to deal with the land. Whether in consequence of advice or in spite of it, it may fairly be said that farmers throughout the United Kingdom have done their duty. They have met their difficulties doggedly, and have shown an appreciation of the situation which does credit to their intelligence. It was not

easy last autumn, when farmers had to lay their plans for the agricultural year, to forecast the future. We were all optimists then, and many thought that the war might be over before the crops then being planted were reaped. It was clear, however, that the national interest lay in maintaining and, so far as possible, increasing the produce of the land. In the quiet determined way which is characteristic of them, farmers devoted themselves to the task, and the returns recently issued give the measure of their achievement. They have added 22 per cent. to the acreage of wheat, and 7 per cent. to the acreage of oats, and they have kept the area of potatoes up to the high and sufficient level of the previous year. These are the three most important crops. They have also not only maintained the stock of cattle, which was the largest on record, but, in spite of unfavourable conditions and a bad lambing season, they have increased the stock of sheep. In view of these facts I venture to say that British and Irish farmers have shown both patriotism and intelligence, and may fairly claim to have contributed their share to the national effort.

The share of British agriculture in the food supply of the nation is more considerable than is sometimes realised. When I last had the honour to address the British Association I ventured to emphasise this point, and I may be allowed to repeat in a somewhat different form, and for a later period, the figures then given. Taking those articles of food which are more or less produced at home, the respective proportions contributed by the United Kingdom, the rest of the Empire and foreign countries were, on the average of the five years, 1910–14, as follows :—

	United Kingdom.	British Empire Overseas.	Foreign Countries.
	Per cent.	*Per cent.*	*Per cent.*
Wheat	19·0	39·3	41·7
Meat	57·9	10·7	31·4
Poultry	82·7	0·2	17·1
Eggs	67·6	0·1	32·3
Butter (including margarine)	25·1	13·3	61·6
Cheese	19·5	65·4	15·1
Milk (including cream)	95·4	0·0	4·6
Fruit	36·3	8·3	55·4
Vegetables	91·8	1·1	7·1

The war has directly affected some of our food supplies by interposing barriers against the exports of certain countries. Fortunately we were in no way dependent for any of these

foods upon our enemies, though Germany was one of our main sources of supply for sugar. We received some small quantities of wheat or flour and of eggs from Germany, Hungary and Turkey, some poultry from Austria-Hungary, and some fruit from Germany and Turkey, but the whole amount was insignificant. The practical cessation of supplies from Russia was the most serious loss, as we drew from thence on an average 9 per cent. of our wheat, 9 per cent. of our butter and 16 per cent. of our eggs.

The rather humiliating panic which took possession during the first few days of the war of a certain section of the population, who rushed to accumulate stores of provisions, arose not only from selfishness but from insufficient appreciation of the main facts about food supplies. Our large imports of food are constantly dinned into the ears of the people, but the extent and possibilities of our native resources are practically unknown. It is very natural, therefore, that the man in the street should assume that even a temporary interruption of oversea supplies would bring us face to face with famine.

Within the first few days of the war the Government, through the Board of Agriculture, obtained returns not only of the stocks of all kinds of food-stuffs in the country but also of the stocks of feeding-stuffs for animals and of fertilisers for the land. Powers were taken under the Articles of Commerce (Returns, etc.) Act to compel holders of stocks to make returns, but it is due to the trading community to say that in only two instances, so far as the Board of Agriculture was concerned, was it necessary to have recourse to compulsion. The returns of stocks of food-stuffs, feeding-stuffs and fertilisers have been made regularly to the Board of Agriculture* every month since the outbreak of war, and the loyal co-operation of the traders concerned deserves cordial recognition by those whose official duty has been rendered comparatively easy by their assistance. I may be allowed to add that the readiness with which traders communicated information, which was of course of a very confidential nature, displayed a confidence in Government Departments which they may regard with some satisfaction.

A very casual glance at the national dietary suffices to show that John Bull is an omnivorous feeder, and as the whole world has eagerly catered for his table his demands are exigent.

* Returns in Scotland and Ireland are made to the Agricultural Departments of those countries, and the results transmitted to the Board of Agriculture and Fisheries.

But, for various reasons, our daily bread, reluctant though most of us would be to be restricted to it, is regarded as the measure and index of our food supplies. On the 4th of August the Board of Agriculture published an announcement that they estimated the wheat crop then on the verge of harvest at 7,000,000 qr., and that, including other stocks in hand, there was at that time sufficient wheat in the country to feed the whole population for fonr months; and a few days later, having then obtained further information from about 160 of the principal millers, they stated that the supplies in the country were sufficient for five months' consumption. The Board also announced on the 5th of August that the potato crop would furnish a full supply for a whole year's consumption without the necessity for any addition from imports. When it was further announced that the Government had taken steps to ensure against a shortage of sugar it began to be generally realised that, at any rate, the country was not in imminent danger of starvation. Indeed, on a broad survey of the whole situation, it was apparent that our native resources, together with the accumulated stocks of various commodities held in granaries, warehouses, and cold stores, would enable the United Kingdom to face even the unimaginable contingency of a complete blockade of all its ports for a considerable period.

Nevertheless it was abundantly evident, not only to the man in the street, but even to those whose duty it was to consider such matters, that the maintenance of regular supplies was essential to avoid undue depletion of stocks. The risk that a certain number of vessels carrying food to this country might be sunk by the enemy was obvious, and it was at first very difficult to measure it. After a year of strenuous endeavour by the enemy it is satisfactory to record that, although a few cargoes of food-stuffs have been sunk, the effect on supplies has been practically negligible.

Under these circumstances it appeared that, provided adequate protection were given against unusual risks, commercial enterprise might in the main be relied upon to supply the demands of the people in the normal manner and in the usual course of business. It is a self-evident axiom that it is better not to interfere in business matters unless there is a paramount necessity for interference.

The machinery of modern business in a highly-organised community is very complicated; the innumerable cogwheels are hidden while the machine is running normally, but every

single one of these becomes very obvious when you attempt to introduce a crow-bar. With one or two exceptions the purveyors of food to the nation were left to conduct their business without official interference, though the Board of Trade took steps to ascertain what were the retail prices justified by the wholesale conditions and to disseminate the information for the protection of consumers against unreasonable charges.

One measure of a drastic and widespread nature was adopted. The exportation of a large number of commodities was prohibited. This was done for two reasons: (1) to conserve stocks in this country, and (2) to prevent goods from reaching the enemy. The latter object could be attained only very partially by this method so long as any sources of supply other than the ports of the United Kingdom were open to the enemy or to adjoining neutral countries. The former object—with which we are now only concerned—was, on the whole, achieved. The Board of Agriculture, concerned for the maintenance of our flocks and herds, at once secured a general prohibition of the exportation of all kinds of feeding-stuffs for animals. Many kinds of food-stuffs were at once included and later additions were made so that for a long time past nearly all kinds of food have been included, though in some cases the prohibition does not apply to the British Empire or to our Allies. The exportation of fertilisers, agricultural seeds, binder twine, and certain other commodities more or less directly connected with the conservation of our food supplies, was also prohibited, so that generally it may be said that the outlet for any food in the country was under effective control. This is not the time or place to discuss the reasons why in some instances limited quantities of certain articles were allowed to escape under licence. It is only necessary to remark that in all such cases there were cogent reasons, in the national interest, for the action taken.

Direct Government intervention in regard to food supplies was limited to three commodities—sugar, meat and wheat. In the case of sugar the whole business of supply was taken over by the Government, a huge undertaking, but administratively a comparatively simple one, owing to the fact that there are no home-grown supplies. Intervention in the meat trade was necessitated by the fact that the enormous demands of the Allied armies had to be met by drafts upon one particular kind of meat and mainly from one particular source. The Board of Trade co-operated with the War Office, and a

scheme was evolved whereby a very large part of the output of meat from South America and Australia comes under Government control.

As regards wheat the intervention of the Government took two forms. The scheme whereby the importation of wheat from India was undertaken by the British Government, in co-operation with the Indian Government, arose primarily from conditions in India rather than from conditions in the United Kingdom, although it is hoped and believed that the results will prove to be mutually advantageons. Other than this the intervention of the Government in regard to wheat was devised as an insurance against the risk of interruption of normal supplies, its main object being to prevent the stocks of wheat in the country from falling to a dangerous level at a time when the home crop would be practically exhausted. When the home crop is just harvested there are ample reserves in the country for some months, and as the United States and Canada are at the same time selling freely, stocks held by the trade are usually high. While home-grown wheat remains on the farms it is practically an additional reserve supplementary to the commercial reserves. When it leaves the farmers' hands, even although it may not actually go into consumption, it becomes part of the commercial reserve. This reserve in the nature of business tends to be constant, but fluctuates within rather wide limits under the influence of market conditions. If the price of wheat rises substantially, and the capital represented by a given quantity increases, there is a natural tendency to reduce stocks. If also there is any indication of a falling market ahead, whether from favourable crop prospects or the release of supplies now held off the market for any reason, a prudent trader reduces his stocks to the smallest quantity on which he can keep his business running. So long as shipments reach this country, as in normal times they do, with, as a member of the Baltic once expressed it to me, "the regularity of omnibuses running down Cheapside," the country may safely rely on receiving its daily bread automatically. But if any interruption occurred at a time when the trade, for the reasons just indicated, happened to be running on low stocks the margin for contingencies might be insufficient. I am, of course, debarred from discussing the method adopted or the manner in which the scheme was carried out, but as the cereal year for which it was devised is over, it is permissible to state that the object in view was successfully achieved.

Of the 47,000,000 people who form the population of the United Kingdom the large majority are absolutely dependent for their daily food on the organisation and regular distribution of supplies. The countryman, even if he possesses no more than a pig and a garden, might exist for a short time, but the town-dweller would speedily starve if the organisation of supplies broke down. He does not, perhaps, sufficiently realise the intricacy of the commercial arrangements which make up that organisation, or the obstacles which arise when the whole economic basis of the community is disturbed by a cataclysm such as that which came upon us thirteen months ago. The sorry catchword, "Business as usual," must have sounded very ironically in the ears of many business men confronted with unforeseen and unprecedented difficulties on every side. The indomitable spirit with which they were met, the energy and determination with which they were overcome, afford further evidence of that which has been so gloriously demonstrated on land and sea, that the traditional courage and grit of the British race have not been lost.

To the question, how have our oversea food supplies been maintained during the first year of the war, the best answer can be given in figures.

Imports of the principal kinds of food during the first twelve months of the war were as under, the figures for the corresponding period of 1913-14 being shown for comparison:—

	1914-15.	1913-14.	Increase (+) or Decrease (—)
	Thousands of cwt.	*Thousands of cwt.*	*Per cent.*
Wheat (including flour) ..	113,797	115,398	— 1·39
Meat	15,868	18,026	— 11·97
Bacon and hams..	7,452	5,975	+ 24·72
Cheese	2,766	2,386	+ 15·93
Butter (including Margarine) ..	5,376	5,748	— 6·47
Fruit	18,830	17,512	+ 7·53
Rice	9,573	4,840	+ 97·79
Sugar	35,029	38,356	— 8·67

In total weight of these food-stuffs the quantity brought to our shores was rather larger in time of war than in time of peace. And one still occasionally meets a purblind pessimist who plaintively asks what the Navy is doing? This is a part of the answer. It is also a measure of the success of the much-advertised German "blockade" for the starvation of England. So absolute a triumph

of sea-power in the first year of war would have been treated as a wild dream by the most confirmed optimist two years ago. The debt which the nation owes to our sailor-men is already immeasurable. That before the enemy is crushed the debt will be increased we may be assured. The crisis of our fate has not yet passed, and we may be called upon to meet worse trials than have yet befallen us. But in the Navy is our sure and certain hope.

> "*That which they have done but earnest of the things that they shall do.*"

Under the protection of that silent shield the land may yield its increase untrodden by the invading foot, the trader may pursue his business undismayed by the threats of a thwarted foe, and the nation may rely that, while common prudence enjoins strict economy in husbanding our resources, sufficient supplies of food will be forthcoming for all the reasonable needs of the people.

SYSTEMS OF FARMING AND THE PRODUCTION OF FOOD.—THE NEED FOR MORE TILLAGE.

T. H. MIDDLETON, C.B., M.A., M.Sc.,

Assistant Secretary, Board of Agriculture and Fisheries.

THE following paper was read at the meeting of the British Association, held at Manchester, 7th-11th September, 1915 :—

Since the outbreak of war the greatest interest has been taken by all classes of the community in questions relating to food production ; the correspondence now received by the Board of Agriculture and Fisheries refers to a group of subjects to which the British public have paid little attention in recent years, but which a century ago occupied most of the office hours of Sir John Sinclair, Arthur Young, and other members of the staff of the old Board. To Germany the organisation of food production is of vital importance, and early in the war the subject engaged the attention of a committee of experts presided over by Dr. Eltzbacher, of Berlin. A summary of the report of this committee appeared in the *Lancet* last February, and recently an English translation has been issued by the University of London Press under the title "Germany's Food. Can it last ?" Quite apart from the object of the enquiry and its bearing on present conditions, the report of Dr. Eltzbacher's committee is of much interest to agriculturists. The considerations

advanced, the lines of thought developed, and the methods for increasing food supply recommended, should help to stimulate production from the soil when peace follows war, and the committee's report is one which every student of agriculture may be recommended to read.

Some months ago, when I was asked by the committee of the Section to share in a discussion on *The Effects of the War on the Future of British Agriculture*, it appeared to me that one obvious question which might profitably engage our attention to-day is: " To what uses are we putting our English soil ? "

Instead of discussing the financial aspects of different systems of agriculture it is desirable to enquire whether there may not be profits and losses of another kind which should receive the carefnl consideration of agriculturists responsible for the examination of the merits of various styles of farming. Discussion of the systems likely to produce the greatest amount of food were common enough towards the end of the 18th century and in the early years of the 19th, but our fathers and grandfathers gave the question little thought. The steamship and the railway appeared to them to make this subject of small practical importance. Now the possible developments of the submarine and the airship have modified the public's point of view, and the importance of growing more food within the country, not only as a war measure but after the return of peace, is being urged upon our attention by many thinking people.

I propose to restrict my paper to the examination of three systems of farming:—(1) the production of meat on grass land; (2) the production of milk on grass land; and (3) the production of meat and food crops on arable land. In each case I shall attempt to estimate the probable amount of human food produced. In the first place I shall estimate the quantity of saleable produce which each system is likely to yield, and I shall then endeavour to compare the values of the different kinds of produce as food for men. With the exception of the poor pasture I have assumed that the examples refer to well-farmed land; but to avoid overburdening the examples with figures I have restricted the crops grown and the kinds of stock kept; I have also excluded the food value of meat offals.

SYSTEM I.—*The Production of Meat on Grass Land.*

In this case, owing to the widely different quality of pastures, it will be desirable to estimate the yield on land of medium quality adapted for raising store cattle and sheep, on rich fattening pastures, and on the poorest type of grazing land.

A.—*Grazing Land of Medium Quality adapted for rearing Store Stock but not for Fattening Cattle.*—I propose to take as an example of land of this kind some fields on the Northumberland Experimental Station, Cockle Park, for which the records of 11 years' grazing (1904–1914) are available. The fields in question form part of the Hanging Leaves Fields Experiment. The land, which formerly grew wheat, was in very poor condition when the Experimental Farm was taken by the Northumberland County Council, but by using basic slag the pasture had been much improved before the experiment started. Since that time the land has been regularly manured and the grass is now of very fair quality. Each of the experimental fields is 10 acres in area. Two of them (Nos. I. and IV.) have been manured with basic slag, and slag and fish meal, respectively. The results have been similar (186 lb. live weight increase per acre on No. I. and 192 lb. on No. IV.) and the average returns from this area of 20 acres may be adopted for the purpose of our estimate.

The stock consisted chiefly of cattle, but sheep were also grazed. The numbers varied from season to season with the carrying capacity of the grass. The usual stock per 10 acres during the summer grazing season of 14 to 16 weeks varied from 6 to 8 cattle, with 6 ewes and 12 lambs. In addition there was autumn and winter grazing for sheep valued on the average of 11 years at 7*s.* 4*d.* per acre. The average annual live weight increase of the stock on Fields I. and IV. during the summer season has been 189 lb. per acre, the highest increase (1907) 250 lb., and the smallest (1905) 132 lb. The low yield in 1905 as compared with 1907 was partly due to the manuring; but the season is now the chief factor in modifying yield, for in 1910, when the manurial position was the same as in 1907, the yield was only 170 lb.

Of the average increase, 60 lb. comes from sheep and 129 lb. from cattle. The increase during autumn and winter grazing has not been determined, but the increase from sheep in the autumn on the adjacent experiment in Tree Field has been shown to be very small: usually about 2 lb. per acre per week in September. The average value of the winter grazing on Hanging Leaves has been estimated at 7*s.* 4*d.* per acre. Summer increase in cattle is valued at $2\frac{2}{3}$*d.* per lb. Autumn and winter increase on grazing farms must cost at least 50 per cent. more to produce, so that 7*s.* 4*d.* worth at, say, 4*d.* per lb. would amount to 22 lb. Adding this to the summer increase, the total live increase of cattle and sheep would amount

to 211 lb. per acre. Experiments on sheep at Cockle Park show that in store stock the percentage of carcass to live weight increase during the grazing season is low, and it is improbable that so much as 50 per cent. of the total live increase is carcass, but for our present purposes it will be desirable to estimate that half the live increase represents carcass. It follows that this grass land of moderate quality which has been properly manured and carefully grazed has on an average of 11 years produced about 105 lb. per acre of lean meat.

B.—*Grass Land of High Quality adapted for Fattening Cattle.*—I have no definite records corresponding to those supplied for medium quality pasture by Cockle Park, and propose to base the estimate on information obtained from the occupier of some of the finest grass land I have seen. This fine grass land fattened one 3-year old bullock per acre in the early part of the grazing season, and after the first lot of cattle was marketed a second lot could be fattened if oilcake were used; if not the second lot could be made into very good store cattle suitable for fattening for the Christmas markets. It may be estimated that in the early grazing season of 90–100 days cattle would increase by 200 lb. per head and that of this amount 120 lb. would be fat meat. The second lot of cattle would increase by about 100 lb. in 70 days' grazing, and this increase would probably contain 55 lb. of moderately fat meat.

In the late autumn, there would be some grazing for store cattle and sheep which might produce about 30 lb. live increase and 15 lb. of lean meat. I estimate the average total yield from this land of first-rate quality at about 330 lb. live and 190 lb. carcass increase per acre. Under some conditions the live increase would be considerably greater, but it is unlikely that the actual production of meat would exceed 190 lb.

C.—*Grazing Land of Very Poor Quality.*—As an indication of the increase that may be expected from pastures of the poorest type, we may take figures available from experiments made in Northumberland, Northamptonshire, and Cambridgeshire, on boulder clay of very poor quality. The statement on p. 524 shows the live weight increase per acre, between the years 1900 and 1905, obtained on untreated soil in these experiments. The period has been selected as one in which all the experiments were in progress, and a five-year average in each is sufficient to correct seasonal variations. The yields in all three cases are similar, averaging 36, 47, and 53 lb. live weight increase per acre. The greater increase on the southern stations is probably due more to the warmer season, and the earlier period

at which grass comes in the spring, than to the soil. The average increase at these three stations, namely, 45 lb. live weight, may be taken as representing the amount which the poorest pastures are producing. The fourth column in the statement gives the increase on a pasture in Hampshire, which, although accounted poor in its own neighbourhood, is of much better quality than those above referred to. In that case the average live increase was 107 lb. per acre.

Live Weight Increase per acre, from Unmanured Soil.

Year.	Station.			
	Cockle Park, Northumberland.	Cransley. *Northants.*	Hatley, Cambridgeshire.	Sevington, *Hampshire.*
	lb.	*lb.*	*lb.*	*lb.*
1900	44	—	67	—
1901	23	45	46	100
1902	41	72	78	126
1903	41	42	38	117
1904	33	38	36	90
1905	—	37	—	103
Average ..	36	47	53	107

Even in favourable grazing seasons it is unlikely that as much as 50 per cent. of the live weight increase would consist of meat on this poor land. The lack of condition of the sheep fed on such pastures at the end of the grazing season is very marked, and it is doubtful if 45 lb. live increase would on the average represent so much as 20 lb. gain in carcass, but for the purpose of my estimate 20 lb. of meat may be adopted as the return likely to be secured from an acre of very poor pasture.

SYSTEM II.—*Milk Production on Grass of Good Quality.*

In this case we may suppose the grass land to be suitable for dairying, of good, but not first-rate quality, and under good management; 100 acres should maintain from 25 to 30 cows and some young stock. Let us assume that 30 cows, 6 heifer calves, and 10 heifers constitute the stock; further, that the cows yield on an average 650 gal. of milk per annum. This would work out at 195 gal., or 2,000 lb. of milk, per acre. In confirmation of this estimate results obtained in experiments may be cited. At the Midland College, manured grass land stocked with good cows produced about 220 gal. of milk per acre. At Harper Adams College, on

unmanured land, about 190 gal. per acre was secured; and on well-manured land, 260 gal. It should be noted that in these experiments the whole of the land was producing milk, whereas on the 100-acre farm in question part of the grass is reserved for other stock.

In addition to milk, the farm should be credited with the sale of draft cows. Assuming that there was pasture available on which these could be fattened, an average of 5 cows per annum would be sold yielding, say, 3,500 lb. of meat or 35 lb. per acre. There would also be from 20 to 24 calves for sale. If sold at, say, one week old, for rearing, they would weigh about 65 lb. and contain 35 lb. of meat. This would give a total of 840 lb. of meat for the farm. Every second or third year a bull would be sold and the increase on this animal might amount to 160 lb. of meat per annum, bringing the total yield of meat to 45 lb. per acre per annum.

Under ordinary circumstances feeding stuffs would be purchased and a correspondingly larger stock maintained, but to avoid complicating the estimate it is assumed that the cows receive no winter food other than hay.

SYSTEM III.—*Production of Food Crops and Meat from Arable Land.*

In this case we may take as an example a farm of 100 acres of good loamy soil worked on an ordinary 4-course rotation. In order to make the example a simple one it is assumed that all the crops grown which are not required for the working horses are consumed by 50 2-year-old bullocks, house-fed for 26 weeks, and that no sheep or pigs are kept. The arable land is supposed to be cropped in the following way: (1) the root-break consists of 10 acres of mangolds, 10 of swedes and turnips and 5 of potatoes; (2) on land following roots there are 15 acres of barley and 10 of wheat; (3) the seeds are cut twice and converted into hay; (4) after seeds 15 acres of wheat and 10 acres of oats, for horse corn, are grown.

Wheat, barley and potatoes are sold. It is assumed that all inferior barley is ground and fed on the holding, and that about one-quarter of the crop is, on an average, disposed of in this way, the remainder being converted into beer. The exact disposal of the crops is indicated in the statement on p. 526. It will be seen that, when the horses and live stock have been supplied, 25 tons of potatoes, 450 bush. of barley and 750 bush. of wheat are available for sale. It is assumed that the wheat offals and brewers' grains are repurchased and used for the cattle.

The yield of meat has been calculated as follows:—It is supposed that 50 well-bred cattle, averaging 20 months old

Estimate of Crops produced on 100 *acres of well-farmed Arable Land of good quality, worked on a four-course rotation. Four working horses kept. Fifty 2-year-old bullocks house-fed for* 26 *weeks.*

Cropping.	Crop per acre.	Total Yield.	Disposal of Crops. Kept for Seed.	Fed to Horses.	Fed to Cattle.	Used as Bedding.	Sold.
						Tons.	
10 acres Mangolds	20 tons	200 tons	—	—	200 tons	—	—
10 ,, Swedes and Turnips	16 ,,	160 ,,	—	3¾ tons	156¼ ,,	—	—
5 ,, Potatoes	7 ,,	35 ,,	3¾ tons	—	6¼ ,,	—	25 tons
15 acres { Barley	44 bush.	660 bush.	45 bush.	—	165 bush.	—	450 bush.
{ ,, straw ..	22 cwt.	16½ tons	—	—	6½ tons	10	—
10 ,, { Wheat	36 bush.	360 bush.	30 bush.	—	30 bush.	—	300 bush.
{ ,, straw, &c...	1½ tons	15 tons	—	—	3 tons	12	—
25 acres Seeds hay (cut twice)	40 cwt.	50 tons	—	16 tons	34 tons	—	—
15 acres { Wheat	36 bush.	540 bush.	45 bush.	—	45 bush.	—	450 bush.
{ ,, straw, &c...	1½ tons	22½ tons	—	—	4½ tons	18	—
10 ,, { Oats	48 bush.	480 bush.	40 bush.	440 bush.	—	—	—
{ ,, straw ..	1½ tons	15 tons	—	—	15 tons	—	—

and 900 lb. live weight, are purchased in the autumn and fed for 180 days on an average daily ration of 84 lb. roots, 3¼ lb. grain and millers offals, 8 lb. hay and 8 lb. straw. Well-

managed cattle fed on this ration should put on about 1¾ lb. live weight per day, or 15,750 lb. in the period; 60 per cent. of the increase may be reckoned as carcass, so that the total carcass increase would amount to 9,450 lb. of fat meat. In the example it has been assumed that the cattle are fed entirely on the products of the farm. Better results would usually be got by selling more barley and purchasing oil-cakes. Much more food might be produced if more intensive methods of farming had been adopted, and if dairy cows partly replaced fattening cattle.

In addition to meat the sales include wheat, barley and potatoes. It is assumed that the wheat yields 70 per cent. of flour and 25 per cent. offals available for stock feeding; that the barley is converted into beer (54 lb. producing 10½ gal. beer and 14 lb. dried grains); that the dried brewers' grains are given to cattle, and that the potatoes are sold during the autumn and winter. As potatoes are subject to waste in keeping and also in preparing for food, a loss of 20 per cent. has been allowed for; thus of the 25 tons available for sale 20 tons only are assumed to be eaten.

The total amount of produce reaching the consumer's table would thus be:—

Meat, including bone, etc.	9,450 lb.
Wheat flour	31,500 ,,
Potatoes	44,800 ,,
Beer	4,725 gal.

The results obtained by the different systems of farming which have been discussed may now be summarised. The quantities of food which an acre has been estimated to produce are:—

I. Grazing, Medium Pasture, Meat	105	lb. per acre.
Rich ,, ,,	190	,, ,,
Poor ,, ,,	20	,, ,,
II. Dairying, Good ,, Milk	2,000	,, ,,
,, ,, Meat	45	
III. Arable Land, Wheat Flour	315	,, ,,
,, ,, Potatoes	448	
,, ,, Meat	94	
,, ,, Beer	498	

The Food Value of different kinds of Produce.

The value of these farm products as human food may next be considered. They include produce differing widely in composition, as wheat flour and potatoes, meat of two kinds, and a beverage. With the object of reducing the number of figures it will be desirable to assume in the following discussion that the meat consists of beef only, the increase derived from sheep being added to the increase of cattle. It will also be

necessary to adopt a suitable standard or standards of comparison, the foods having different properties. Money value, which forms the usual measure, is unsuitable, since the physiological value of a food does not depend on the price. Instead of treating the human animal in the usual way and supplying him with as many pounds of beef, potatoes and beer as he chooses to pay for, we must deal with him as we do with farm animals and enquire into the composition of the daily ration of albuminoids, fats and carbohydrates which he actually requires.

In the first place let us recall the fact that foods are required by the animal for two distinct purposes, namely, to supply (1) the materials from which the body is built up, from which secretions like milk are made and from which the daily waste of the tissues may be repaired; (2) the fuel which in the body is converted into heat and work.

Common foods coutain three groups of constituents, the proteins (albuminoids), fats and carbohydrates. If small quantities of certain salts, always present in mixed foods, are provided, the proteins can perform both the functions required of a food. Fats and carbohydrates, in the absence of protein, could only produce heat and work. It follows that in estimating the relative values of the different foods produced by a farm we must adopt two standards, and ascertain (1) the amount of digestible protein, (2) the total amount of energy which the food can supply.

Since digestible protein is an expensive food to produce and is worth no more for the production of energy than the cheap carbohydrates sugar and starch, economical rations aim at supplying as small a part of the total food requirements in the form of digestible protein as possible. For the purpose of the estimates which follow, I have allowed ¼ lb. digestible protein as a sufficient daily ration for an average man doing a moderate amount of work, and I have further assumed that enough digestible fats and carbohydrates must be added to the protein to give a total energy value of 3,500 calories per day.*

The requirements of a man vary, of course, with his size, and still more with his activity, and there is a good deal of difference of opinion as to the actual ration necessary for the ordinary individual. The Eltzbacher committee have come to

* The calorie is the unit adopted in measuring the capacity of foods to produce heat and work in the animal body It consists of the amount of energy which when expressed as heat would raise the temperature of 1 kilogramme (2·2 lbs.) of pure water from 0° C. to 1° C.

the conclusion that the average German civilian requires from 70 to 80 grammes of digestible protein (about $\frac{1}{6}$ lb.) and 3,000 calories daily; they agree that 4,000 calories, or more, may be needed by men who exercise their muscles freely, but argue that even when working hard an average healthy adult need not increase his protein ration. There are very special reasons why Germany must economise protein at the present time, and in selecting a more liberal ration than that recommended by the Berlin committee in framing these estimates, I have followed the opinion of Atwater, whose extensive investigations into the dietaries of different nations entitled him to write with authority on a subject depending on so many variables as the human ration. It is within the ordinary experience of all of us that not only do food-stuffs differ in composition and average digestibility, but that the digestion of the individual varies with himself, his miller, his baker and his cook. On the other hand, since my object is to estimate the full capacity of farm land to produce food, I have made no allowance for extravagance. I have, therefore, selected $\frac{1}{4}$ lb. of digestible protein and 3,500 calories, as indicating the composition of a moderate diet on which the average man may maintain a very comfortable existence and, if he does not take much exercise, may even grow fat!

In the table printed on page 531 I have estimated the weight of digestible protein and the number of calories yielded by meat, milk and other farm produce. The calories have been ascertained by assuming that 1 lb. of digestible protein or carbohydrate would yield 1,860, and 1 lb. of fat 4,225, calories. The barley crop presents some difficulty. The calorific value has been calculated on a beer containing 5 per cent. of alcohol and 5·5 per cent. of solids. I have assumed that the beer solids are equal to carbohydrates, and that 1 lb. of alcohol yields 3,175 calories. These estimates are doubtful, and the energy value of beer may be less than one-half of the figure given. On the other hand, the Berlin committee state that about 60 per cent. of the energy value of barley is recovered in beer; this is about twice as much as I have estimated, and I have not seen any analyses of German beers that suggest so high a food value.

Wheat flour, potatoes and milk are all fairly constant in composition and average analyses have been assumed.* Meat

* *Wheat flour* is assumed to contain 11·4 per cent. protein (88 per cent. digestible), 1 per cent. fat, and 75 per cent. carbohydrates (98 per cent. digestible); *Potatoes* to contain 1·2 per cent. pure protein (85 per cent. digestible), ·9 per cent. amides, ·2 per cent. fat, and 21 per cent. carbohydrates (95 per cent. digestible); and *Milk* to contain 3·4 per cent. protein (98 per cent. digestible), 3·6 per cent. fat, and 4·8 per cent. carbohydrates.

presents a somewhat complex question, as it is subject to very wide variations in composition.

It will be observed that in most cases the figures relate to the increase in live-weight of animals of 20 months' old or more. From the experiments made by Lawes and Gilbert at Rothamsted and by Atwater and others in America I have adapted the following scale :—

Composition of Carcass and Carcass Increase.

—	Protein.	Fat.
Increase.	Per cent.	Per cent.
Store Cattle on grass	14	40
Fattening Cattle 20-26 months..	10	55
Half fat 3-year-old Cattle on grass	10	55
Fat 3-year-old Cattle on grass	8	60
Carcass.		
Week-old calves	18	14
Fat cows	16	30

It must be pointed out that not only are figures relating to the composition of carcass *increase* of animals few in number, but that the composition of the increase in the case of store cattle must vary widely. Every purchaser of cattle in late autumn for winter fattening knows how variable their condition is and how much it depends on the weather of the second half of the grazing season. Atwater's analysis shows that the whole carcass of a moderately fat animal suitable for the butcher may contain 30 per cent. fat; Lawes and Gilbert found 34·8 per cent. fat in a fat ox and 22·6 per cent. in a half fat ox. The same authors take 16 per cent. fat as representing the composition of the carcass of lean oxen. These figures sufficiently indicate how widely the composition of the increase made by store animals at grass may vary ; for in a good season stores come off the pastures in a moderately fat condition while in a bad year they may leave the pastures for the farm buildings increased in weight, but as lean as when they went to grass in spring.

In studying the production of food in the table on p. 531, it is necessary, therefore, to remember that not only does the actual increase of animals fed on pasture vary, but that the composition of the increase must vary within somewhat wide limits. In the case of house-feeding the fluctuations are very much less.

Results and Conclusions.

The results secured from the three systems of agriculture, grazing, dairying and arable farming, which have been discussed

above, are set out in the following table in a way that admits of a fair comparison being made between them. The figures are given per acre, but it should be noted that the several kinds of produce of the arable farm do not represent the crops of an acre but $\frac{1}{100}$th part of the crop of a 100-acre farm; thus in the last column the figure 53 opposite potatoes is that derived from $\frac{1}{20}$ acre of potatoes. Similarly on the grass farm each acre is assumed to yield 2,000 lb. milk and 45 lb. meat.

FOOD PRODUCED UNDER DIFFERENT SYSTEMS OF FARMING.

(Figures per Acre).

Type of Farming and Produce. (1)	Food. (2)	Digestible Protein. (3)	Energy Value. (4)	Number of Days Ration for Man. Protein. (5)	Number of Days Ration for Man. Energy Value. (6)
	lb.	*lb.*	*Calories.*		
I.—GRAZING.					
(*a*) Meat on Medium Pasture	105	14·3	204,000	57	58
(*b*) Meat on Rich Pasture	190	16·7	488,400	67	140
(*c*) Meat on Poor Pasture	20	2·7	38,800	11	11
II.—DAIRY FARMING. Good Grass.					
Milk	2,000	67·0	607,400	268	174
Meat	45	7·0	66,200	28	19
Total Products ..	—	74·0	673,600	296	193
III.—MIXED ARABLE FARMING. Good Land. Produce—Wheat					
Flour	315	31·6	502,700	126	144
Potatoes ..	448	8·6	185,500	34	53
Meat ..	94	9·2	236,600	37	68
Beer ..	498	2·5	111,200	10	32
Total Products ..	—	51·9	1,036,000	207	296

The final column in the table compares the systems of farming on the basis of the total amount of energy (heat and work) which they are capable of yielding to the human body Provided that the rations contain a sufficient amount of digestible protein, these energy values may be accepted as a correct measure of food-producing capacity of land farmed as in the foregoing examples.

The differences are very striking. A well-managed arable farm is shown to be capable of supplying about twenty-seven times as much human food as is now produced by our poorest enclosed pastures, five times as much as pastures of moderate quality, twice as much as rich pastures, and about one-half more than well-managed grass dairy land. The arable farm is assumed to fatten cattle, the cropping not being well adapted for the keeping of dairy cows. If some grass land had been attached and all the feeding materials available on the farm had been converted into milk, then, making the very liberal allowance of 10 lb. digestible organic matter for the production of 1 gal. of milk, 155 gal. of milk per acre would have been secured in place of 94 lb. of meat, and the energy value of the arable farm would be increased from 296 to 367 days' food supply and the protein yield from 207 to 383 days' supply.

Under ordinary conditions the energy value is the best measure of the real value of the soil to the population; but, in a country cut off from outside supplies of food, protein may become of equal or greater importance. The report of the Eltzbacher committee shows that from the information available last autumn, Germany was expected to have in stock more than enough food to supply the energy required within the harvest year, but that there was an anticipated shortage of protein, so that the existing supplies could only be made to serve the whole population if the German people altered their manner of living and observed the most rigid economy in the use of foods rich in protein. From the present German point of view the protein figures in the table would, therefore, be of much greater importance than those relating to energy. The value of milk production is clearly brought out when this standard is applied; it will be seen that the dairy farm provides supplies for 296 days as compared with 207 days on the meat-producing arable land. (The crops of the arable land were not selected with the object of getting a high yield of protein. If this were necessary the growing of a few acres of beans and peas would improve the position.) From the standpoint of the balanced ration it may be worth while indicating how well the ordinary mixed farm of two-thirds arable and one-third grass land, producing both meat and milk, would fulfil the requirements of a self-supporting system of agriculture. By combining the products of the dairy and arable farms in the table in the proportion one-third and two-thirds we get 237 days' supply of protein and 261 days' supply of energy.

The protein figures for grazing farms are also interesting. It will be seen that the differences between rich and medium

pasture are much reduced when protein production is substituted for energy production. The reason for this is, of course, that the extra yield of a fattening pasture is mainly fat; but so long as protein can be obtained from other sources, and properly fattened cattle make much higher prices than lean animals in the meat markets, it is desirable to use rich pastures for fattening animals.

Finally, it may be noted that the difference between the returns from the poor and the medium pastures in the particular examples cited above is not due to the soil; the soils are similar and the medium quality pasture has been secured by manuring part of the poor land properly and grazing it skilfully. In cases of this sort the money profits are always substantial; this is proved by the reports issued by the Northumberland County Council on Cockle Park Farm, and there is the further advantage to the public that the improved land is likely to produce five times as much food as the unimproved. The question that forces itself upon us in the middle of this long and exhausting war is this—Can the nation any longer afford to neglect the development of the resources now lying latent in its unproductive grass land?

ON GROWING TWO WHITE-STRAW CROPS IN SUCCESSION.

E. J. RUSSELL, D.Sc.,

Director, Rothamsted Experimental Station, Harpenden, Herts.

THE high prices that have been obtained for wheat during the past nine months have caused many farmers to enquire how far it would be feasible to modify their rotation, so as to grow more wheat during the coming year. It is obvious that, on land already in cultivation, any increase in the wheat acreage must be at the expense of something else, and, before any steps are taken in any particular case, the farmer must satisfy himself that it would be advantageous to produce wheat, instead of the crop that is to be displaced. Each man must decide this point for himself with the help of his expert advisers. The object of this article is to state the conditions under which the ordinary rules of farming have been set aside, and both wheat and barley have been grown for many years on the same land without any marked diminution in yield.

It has long been a tradition of farming that two white-straw crops should not be grown in succession, and the tradition still lives on, in spite of numerous instances where

the practice has been a success; indeed, in some cases, the terms of tenancy still prohibit the practice.

The classical proof that white-straw crops can follow one another without deterioration of the land is afforded by the fields of Rothamsted, where wheat has been grown continuously on the same land for 72 years, with only two seasons' break for fallow, and barley has been grown for 62 years, with only one season's fallow. The experiment was repeated at Woburn, on a much lighter soil, where forty-five crops of wheat have been taken off the same land without any break, and forty-five crops of barley off the barley plots. As a commercial proposition, wheat was grown continuously on Mr. Prout's land at

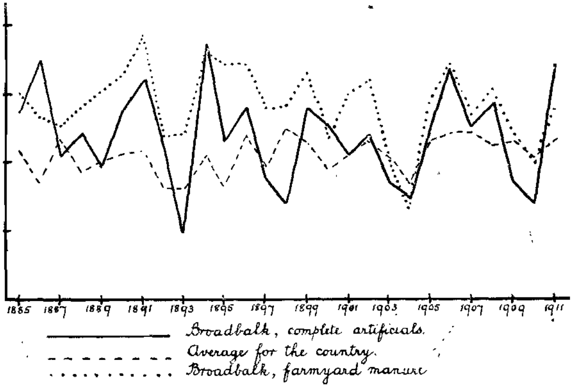


FIG. 1.—Yields of wheat from Broadbalk plots manured with complete artificial manures, and farmyard manure, respectively, compared with the average yield for the whole country.

Sawbridgeworth for 50 years, and this plan was continued until he gave up the farm in 1911.* Other instances are also known where wheat has been grown for a succession of years on the same land, and it may be taken as proved that the practice is quite feasible.

The yields in four of the Rothamsted continuous wheat plots are set out in Table I., and two of them are plotted in Fig. 1,

* Mr. Prout's system is described in "Profitable Clay Farming under a Just System of Tenant Right," by John Prout, 1881, one of the most interesting books on farming the writer has read; and in a Paper by W. A. Prout and J. A. Voelcker, "Continuous Corn Growing in its Practical and Chemical Aspects" (*Journ. Roy. Agric. Soc.*, 1905, Vol. 66, pp. 25–51).

	1844	'45	'46	'47	'48	'49	'50	'51		Average 8 years.
No Manure	15·0	23·3	18·0	16·9	14·8	19·3	15·9	15·9		17·4
Farmyard Manure	22·0	32·0	27·3	30·0	25·6	31·0	28·5	29·6		28·2
	1852	**'53**	**'54**	**'55**	**'56**	**'57**	**'58**	**'59**	**'60**	**'61**	**Av. 10 years.**
No Manure	13·9	5·9	21·1	17·0	14·5	20·0	18·0	18·4	12·9	11·4	15·3
Farmyard Manure	27·6	19·1	41·1	34·6	36·3	41·3	38·8	36·3	32·3	34·9	34·2
Complete Artificials	25·5	11·3	38·8	29·6	32·4	43·8	37·5	30·0	32·6	33·8	31·5
	1862	**'63**	**'64**	**'65**	**'66**	**'67**	**'68**	**'69**	**'70**	**'71**	**Av. 10 years.**
No Manure	16·0	17·3	16·5	13·4	12·1	8·9	16·6	14·3	15·0	9·4	13·9
Farmyard Manure	38·4	44·0	40·0	37·1	32·6	27·5	41·8	38·3	36·5	39·0	37·5
Complete Artificials	43·5	55·5	51·1	44·1	32·5	29·1	47·8	39·0	45·5	34·5	42·3
	1872	**'73**	**'74**	**'75**	**'76**	**'77**	**'78**	**'79**	**'80**	**'81**	**Av. 10 years.**
No Manure	10·8	11·8	11·5	8·6	8·1	8·9	12·4	4·8	11·5	13·8	10·2
Farmyard Manure	32·4	26·8	39·3	28·9	23·9	24·1	28·3	16·0	38·4	30·3	28·8
Complete Artificials	40·8	35·8	38·3	30·5	33·4	40·1	37·3	22·0	34·0	35·5	34·8
	1882	**'83**	**'84**	**'85**	**'86**	**'87**	**'88**	**'89**	**'90**	**'91**	**Av. 10 years.**
No Manure	11·0	13·9	13·0	15·3	9·0	14·9	10·0	12·3	14·0	13·8	12·7
Farmyard Manure	32·8	35·3	32·5	40·1	36·5	34·8	38·0	40·5	43·0	48·5	38·2
Complete Artificials	31·8	43·4	40·5	37·0	44·6	30·6	33·9	29·0	37·3	42·1	37·0
,, ,, (smaller dressing) ..	—	—	—	31·1	32·4	30·8	28·3	26·3	31·8	35·0	(30·8)
Average for whole of England	—	—	—	31·5	26·9	32·3	28·2	29·9	30·8	31·3	(30·1)
	1892	**'93**	**'94**	**'95**	**'96**	**'97**	**'98**	**'99**	**1900**	**'01**	**Av. 10 years.**
No Manure	9·4	9·8	18·0	10·0	16·8	8·9	12·0	12·0	12·3	11·8	12·1
Farmyard Manure	33·4	34·3	45·5	43·9	44·0	37·3	38·0	42·5	33·3	39·6	39·2
Complete Artificials	31·8	19·4	47·0	32·7	37·7	27·5	23·8	37·5	34·9	30·5	32·3
,, ,, (smaller dressing) ..	25·2	17·9	43·4	27·8	32·4	25·8	26·4	25·8	23·7	25·3	27·4
Average for whole of England	26·2	25·8	30·7	26·2	33·9	29·0	34·8	32·8	28·4	30·8	29·9
	1902	**'03**	**'04**	**'05**	**'06**	**'07**	**'08**	**'09**	**1910**	**'11**	**Av. 10 years.**
No Manure	13·3	7·6	4·2	18·0	15·2	9·1	12·4	9·1	7·5	12·4	10·9
Farmyard Manure	41·5	29·7	22·3	38·5	43·6	36·1	39·8	33·8	29·1	36·7	35·1
Complete Artificials	33·5	26·8	24·1	34·2	43·1	34·7	38·1	26·9	23·6	40·4	32·5
,, ,, (smaller dressing) ..	33·1	22·8	17·6	36·7	32·9	30·2	31·7	24·3	23·7	29·9	28·3
Average for whole of England	27·8	30·1	26·5	32·7	33·6	34·0	32·2	33·6	30·2	32·6	31·8

where also are shown the average yields over the whole country for each year. There has, of course, been a falling off on the unmanured land, but this is less than might have been expected; for the last 40 years the yield has been fairly steady, and has averaged 11½ bush. against 17½ bush. for the first five years of the experiment. The plot supplied with farmyard manure shows no falling off, but, on the contrary, a rise: for the first 8 years the yield averaged 28 bush., and for the last 10 years 35 bush. Except in a few really bad years, such as 1912, 1904, and 1879, the crop has been consistently good; whilst often, as in 1892, 1893, 1895, and 1900, it has still been good in spite of the big drop in the average yields for the whole country. The most interesting plot for our present purpose, however, is that supplied with complete artificials, as this most closely represents the case where wheat is grown on a spring dressing. For the first 30 years the yield was well above that on the dunged plot. It has fallen off since, but it was maintained for a sufficiently long period to show that no fall need be anticipated in practice.

The barley results are given in Table II., and lead to substantially the same conclusions. On the dunged plot the yield increased for the first 30 years, and has suffered only a small fall since, whilst complete artificial manures maintained the crop at a good level for the first 20 years, though the yield has not been quite so good in later seasons. Thus it is evident that, provided the proper steps are taken, the average yield can be kept up under a system of continuous corn growing.

For our present purpose, however, we are concerned more with the fluctuations from season to season than with the average. The advantages of rotations are so manifest that no one would advocate any other plan as a permanent system of agriculture or in ordinary circumstances; but to those farmers who, for the period of the war, desire to break their ordinary rotation and get in another corn crop, it is important to know the extent of the fluctuations that may occur. Reference to the diagram shows that the wheat crop which is grown on dressings of artificials does fluctuate more than that on the dunged plots, and that, in a bad year, it is liable to fall considerably, although in a good year it is equally liable to run high. This is further proved by the data in Table III., in which the wheat grown in rotation is compared with the wheat grown continuously. In the good years the continuous wheat comes out high, but in the bad years it is considerably lower.

On an average the Agdell plot, on which wheat is grown in

TABLE II.—*Yield of* BARLEY *(bushels per acre) grown continuously on the Rothamsted plots, receiving farmyard manure, complete artificials, and no manure respectively.*

	1852	'53	'54	'55	'56	'57	'58	'59	'60	'61	Av. 10 years.
No Manure	27·3	25·8	35·0	31·0	13·9	26·1	21·1	13·5	13·3	16·3	22·3
Farmyard Manure	33·0	36·1	56·4	50·1	32·1	51·3	55·0	40·0	41·6	54·4	45·0
Complete Artificials	40·8	38·3	60·6	48·4	31·8	57·4	51·5	34·6	43·5	54·6	46·1
	1862	'63	'64	'65	'66	'67	'68	'69	'70	'71	Av. 10 years.
No Manure	16·5	22·9	24·0	18·0	15·9	17·1	15·6	15·1	13·5	16·8	17·5
Farmyard Manure	49·8	59·5	62·0	52·8	53·1	45·6	43·6	46·9	47·5	54·3	51·5
Complete Artificials	47·6	55·4	55·6	46·5	47·0	43·8	34·6	49·3	38·0	46·5	46·4
	1872	'73	'74	'75	'76	'77	'78	'79	'80	'81	Av. 10 years.
No Manure	10·3	14·0	17·6	12·5	12·8	17·0	10·0	6·3	18·8	17·9	13·7
Farmyard Manure	38·9	54·3	64·5	45·3	45·0	52·0	46·3	36·6	65·3	53·8	50·2
Complete Artificials	36·8	46·8	45·8	36·0	35·8	50·1	33·5	27·3	54·8	42·5	40·9
	1882	'83	'84	'85	'86	'87	'88	'89	'90	'91	Av. 10 years.
No Manure	18·3	16·3	13·7	9·3	11·0	7·5	12·3	11·3	13·0	15·3	12·8
Farmyard Manure	60·8	58·5	57·1	49·3	41·3	26·0	45·0	42·0	53·0	43·8	47·7
Complete Artificials	50·4	52·0	42·3	32·0	35·8	22·6	43·5	35·8	46·4	46·5	40·7
Average for whole of England	—	—	—	35·6	32·2	31·3	33·1	31·6	35·1	34·4	(33·3)
	1892	'93	'94	'95	'96	'97	'98	'99	1900	'01	Av. 10 years.
No Manure	14·0	8·3	10·0	13·3	11·8	5·0	16·7	8·0	8·3	5·0	10·0
Farmyard Manure	59·8	43·3	44·6	49·5	53·8	42·0	51·0	42·0	31·8	25·0	44·3
Complete Artificials	50·6	30·8	41·3	44·3	41·3	30·5	44·5	29·8	24·0	24·8	36·2
Average for whole of England	34·8	28·0	34·7	31·6	33·6	32·5	35·4	34·3	31·0	30·3	32·6
	1902	'03	'04	'05	'06	'07	'08	'09	1910	'11	Av. 10 years.
No Manure	14·3	12·3	6·2	6·5	11·0	7·7	7·2	13·0	9·9	4·9	9·3
Farmyard Manure	42·4	60·0	39·4	39·4	54·8	42·1	52·6	46·3	43·0	23·0	44·3
Complete Artificials	40·3	40·6	32·0	35·5	52·1	32·7	39·1	44·3	38·6	28·5	38·4
Average for whole of England	34·8	31·8	30·5	33·5	34·7	35·7	32·5	36·8	32·6	31·4	33·4

rotation following clover, gives a yield of 35 bush. against 30 on Broadbalk, on which wheat is grown continuously, and the former is also a much steadier crop. It has only twice fallen below 25 bush., once in 1867, and again in that notorious year of disaster 1879, when it was as far down as 13 bush. But the Broadbalk continuous wheat fluctuates to a much greater extent, and the yield has frequently dropped below 25 bush.

TABLE III.—*Steadying effect of Clover Residues on Yield of Wheat grown in Rotation.*

	Agdell. After clover ploughed in ; complete artificials.	Broadbalk. After previous wheat crop ; complete artificials.
	Bush.	Bush.
Average of all	35	30
Highest yield, 1863	46	56
Bad years, 1871	25	13
,, ,, 1875	31	11
,, ,, 1879	13	5
,, ,, 1903	28	24

Thus it is more speculative to grow wheat in succession than in rotation, and hence the practice is justifiable only where the working cost is low so that no great amount of money is involved, as in prairie farming, or else where prices are high, as in our present war conditions. The practical conclusion is, therefore, that the farmer can, if he wishes, take wheat after wheat, instead of following his ordinary rotation, but he runs greater risk of diminished yields if the season turns out to be bad. There is less risk when farmyard manure is used than when artificials are applied.

Experience has shown that two conditions are essential to success : (1) First and foremost the land must be reasonably clean, and fortunately the farmer can see this before making up his mind in the matter. If the land is foul, the risk of failure is too great to be worth taking. If it is fairly clean, however, the best procedure is to cart the shocks as speedily as possible and plough at once. All experience demonstrates the necessity for this. At Rothamsted it has always been recognised that success could only be achieved by ploughing early and then sowing early. Mr. Prout threw down his hedges and straightened out his fields so that he could save time, and he used to put his steam tackle to work immediately the standing corn was out of the way.

It has been suggested (though the writer is not aware of any actual experiments) that a quicker and equally effective preparation for the second wheat crop would be to send the disc

harrows over the land immediately the crop is off, in order to break up the surface and cause the retention of sufficient moisture to allow of the germination of weed seeds. The young weed plants could then be destroyed by the subssquent ploughing.

In spring it is necessary to have recourse to horse-hoeing, and if necessary to hand-weeding to keep the crop clean.

At the present time the land is in a not unfavourable state for extra wheat crops. The summer has not been wet enough for the formation of the beds of couch which give so much trouble, but which, nevertheless, must be got rid of before corn crops will grow.

If a farmer were deliberately setting out to grow two successive crops of wheat his most hopeful way would be to take an early sort as the first crop and a late-sown variety as his second, so as to lengthen the interval available for autumn cleaning.

(2) Assuming that the land is reasonably clean, the second requisite is a suitable spring dressing. In the ordinary way a spring dressing would be applied only if the crop seemed to require it. A second corn crop, however, must be treated more generously, and should receive a spring dressing as a matter of course; even if the corn looks well at the beginning of the year it is liable to finish badly unless it is given some help.

The spring dressing has to be based on the rather special circumstances of the second crop. In the first place, the tilth is not likely to be as good after a previous corn crop as after, say, a root crop, and if much rain falls in winter the condition of the soil in spring may be unsatisfactory. Soot is a useful corrective for this, and its effects are too well known to need description. Unfortunately, it is rather an indefinite substance, and cannot always be obtained. Chemistry has come to the rescue and placed the active fertilising ingredient on the market in the form of sulphate of ammonia. Whether this is a complete substitute for soot is not clear, and could only be ascertained by a definite experiment, but, at any rate, it tends to improve the tilth and should be used whenever there is any difficulty in this direction and where soot cannot be got in sufficient quantities. In the second place some nitrogen compound is almost always necessary, and this may be supplied by soot, sulphate of ammonia, or nitrate of soda. As a rough guide, 1 bush. of soot may be regarded as containing 1 lb. of nitrogen, so that 22 bush. of soot, which would be quite an ordinary dressing, would be equivalent to 1 cwt. of sulphate of ammonia.

Sulphate of ammonia should go on early, before the crop begins to show the need for it. The farmer must make up his mind that a spring dressing is desirable in any case and put it on.

When there is no difficulty about tilth, nitrate of soda may be used. It gives rather a bigger yield per unit of nitrogen and has rather less tendency to cause the crop to lodge, or the straw to lose colour. In present circumstances it has the further advantage of increasing the supplies of potash available to the plant. If the winter turns out wet, however, it should not be used on heavy lands that have "poached" badly.

Phosphates also are needed. They help the young wheat plant to get over the difficulty of a bad tilth in spring, and they give it an early start, the advantage of which is felt all through its life. For this special purpose superphosphate is the best fertiliser to use.

The question of amount is not easy to decide. The Rothamsted experiments have shown that, so long as the dressing is suitable and within reasonable limits, the more that is put on the bigger the crop. Certain disadvantages may become manifest when large dressings are used: the crop may be laid, or the straw lack brightness of colour, but the total yield increases. Beyond a certain point, however, the extra crop does not pay for the extra manure. This is shown in Table IV. The 200-lb. dressing of ammonium salts, costing about 26*s.*, gives an increase of 8·7 bush. of grain and 9·3 cwt. of straw; the double dressing gives more than double the increase in crop; but three times the dressing does not give three times the crop. When wheat is at 30*s.* and straw at 20*s.* the double dressing is the most profitable, giving 1*s.* more than the return from the largest dressing, without taking into account the saving in the cost of harvesting. When wheat is at 50*s.*, however, and straw at 20*s.* the case is different: the highest dressing gives 10*s.* more return than the middle one, which, even after allowing for the extra cost of harvesting, is still profitable.

TABLE IV.—*Influence of increasing Dressings of Nitrogenous Manures on Yield of Wheat, Broadbalk Field; Average of the* 61 *years* 1852–1912.

—	Grain.	Increase per 200 lb. ammonium salts.	Straw.	Increase per 200 lb. ammonium salts.
	Bush.	Bush.	Cwt.	Cwt.
Mineral manure alone ..	14·5	—	12·1	—
Mineral manure + 200 lb. ammonium salts ..	23·2	8·7	21·4	9·3
Mineral manure + 400 lb. ammonium salts ..	32·1	8·9	32·9	11·5
Mineral manure + 600 lb. ammonium salts ..	36·6	4·5	41·1	8·2

Cost and Value of Increased Produce.

(a) Ordinary circumstances; Wheat at 30s., straw at 20s.

	Single Dressing.	Double Dressing.	Treble Dressing.
	£ s. d.	£ s. d.	£ s. d.
Value of increase ..	2 1 11	4 6 10	5 11 10
Cost of extra manure ..	1 6 0	2 12 0	3 18 0
Profit on extra manure	0 15 11	1 14 10	1 13 10

(b) Special circumstances; Wheat at 50s., straw at 20s.

	Single Dressing.	Double Dressing.	Treble Dressing
	£ s. d.	£ s. d.	£ s. d.
Value of increase ..	3 3 8	6 10 10	8 7 1
Cost of extra manure ..	1 6 0	2 12 0	3 18 0
Profit on extra manure	1 17 8	3 18 10	4 9 1

The additional cost of harvesting the larger crops is not included, and has still to be deducted from the profits.

Under the special circumstances it will probably be safe to err on the liberal side. A good wheat-grower, with whom the writer discussed the problem, said that he should "think of a good dressing, then double it," and no doubt the underlying principle is sound enough, even though the opinion was not intended to be taken literally.

One cwt. of sulphate of ammonia or nitrate of soda would, in normal circumstances, be considered enough; and this was the amount of nitrate used by Mr. Prout over a long series of years. If the price of wheat keeps high, however, larger dressings might well be used. Too much sulphate of ammonia, however, may cause the crop to lodge and the straw to lose colour, whilst too much nitrate of soda would also cause lodging and might affect the tilth of heavy land.

The dressing of phosphate presents less difficulty. Phosphatic fertilisers have the enormous advantage that no reasonable dressing ever causes injury, while no waste arises, because any excess left over from one season usually lies safely in the soil for the next crop. As a spring dressing for wheat 2 to 4 cwt. of superphosphate could be applied. The general rule is that light soils in dry districts need but little phosphate, if any, for wheat, while heavy soils in wet districts require a good deal.

Fen soils, especially those that lie over clay, and are periodically improved by claying, also respond well to phosphates.

Potash manures are not usually wanted for corn crops, and in any case cannot be got. They are most likely to be needed on light soils where rainfall is low, but on these soils fortunately a dressing of 1 to 2 cwt. of salt usually does all that is requisite.

Safe dressings would probably be as follows :—

Light soils with less than 24 *in. of rain per annum* :—

1 to 2 cwt. of nitrate of soda.

2 cwt. of superphosphate.

2 cwt. of salt.

Heavy soils with more than 28 *in. of rain per annum* :—

1½ to 3 cwt. of nitrate of soda, or if bad tilth is feared, sulphate of ammonia, or 30 bush. of soot.

4 cwt. of superphosphate.

To be applied early in the year.

No general formula can be given for intermediate cases, but the rule is that as the rainfall increases so the need for phosphate increases ; and as the soil becomes heavier more phosphate is required, while sulphate of ammonia should be used in preference to nitrate of soda.

THE MANURING OF GRASS LAND.

THAT the proper treatment of grass land in this country is a matter of the greatest importance is evident from the fact that in 1915, as compared with some 10,966,000 acres of arable land, there were nearly 16,088,000 acres under permanent grass, exclusive of 3,765,000 acres of mountain and heath land used for grazing. If the area under clover, sainfoin, and rotation grasses be added to the permanent grass area the total acreage of grass in England and Wales in 1915 amounted to 18,450,000 acres, and the hay crop from that part of this area set apart for hay has averaged 8,000,000 tons in the past ten years.

If it were possible to increase the hay crop alone by only one tenth, this would represent an increase in value of over £2,500,000 on the basis of the valuation used in the Agricultural Census (and disregarding the present exceptional conditions) ; while if the value of the animals, wool, dairy produce and poultry sold off the farms for consumption could be similarly and simultaneously increased by one-tenth, this would, on

the same basis, represent a total increase in value of some £8,300,000.

Quite apart from the present conditions as regards high prices of hay and purchased feeding stuffs and, on the other hand, increased prices of meat and milk, there are, therefore, very good reasons why every effort should be made to increase the productivity of grass land.

At the present time the Board are strongly impressing upon farmers the desirability of bringing more grass under the plough ; this, by adding to the demand for store cattle for fattening, furnishes an additional reason for improving the pastures remaining for rearing young stock. It must be pointed out, too, that judicious manuring of grass land has a very favourable effect on tillage crops grown on the broken-up pasture.*

The definite treatment of fields as either pasture or meadow may be referred to at the outset since it has some bearing on the question of manuring. On soils suited to the really first-class types of grass land, fields should be set aside either as pasture or meadows, the reason being that when a field is under hay and manured accordingly certain strong-growing grasses which go to make a big hay crop are encouraged ; when the field is grazed the finer bottom herbage is more suited by the conditions. If the two practices are alternated, encouragement and repression in turn of the several pasture plants occurs, and the best results from neither practice are obtained. On moderate quality pasture and meadow land, however, if repetition of the same practice is continued too long without judicious manuring, deterioration will set in eventually. The value of taking a hay crop from pasture in certain circumstances is referred to later. On the other hand the plants in a field long under hay produce less and less of the best grassy herbage, and as the yield becomes thin the weed plants gain ; the herbage of these failing meadows would gradually be improved by continued depasturing.

The effect of manures on herbage is a point that may be further referred to here. Nitrogenous manures stimulate the growth of grasses at the expense of clovers, trefoils, and vetches, while phosphatic and potassic manures lead to an increase in the clovers. In the latter case, however, the land becomes enriched in nitrogen since the leguminous plants

* Professor Somerville has shown that the first tillage crop grown on broken-up pasture is likely to be 50 per cent. higher if the pasture has been judiciously treated.

collect the free nitrogen of the air, and this, in turn, reacts on the grasses; so that in a few years there is a marked accumulation of humus, as is evident from the thicker and closer sward.

N.B.—For the sake of completeness, various recommendations are made in the following pages with regard to the employment of kainit and sulphate of potash, but probably the only potassic manuring generally practicable at the present time is in the form of guano containing a small percentage of that ingredient.

It is perhaps unnecessary to point out that the supply of plant food in the soil is only one of the factors that determine its fertility; no manures can take the place of a system of draining, or increase the depth of the soil if the latter is badly drained or insufficiently supplied with moisture.

Seeds Hay.

The manuring of seeds hay is often unnecessary, but if it is decided to undertake manuring the course followed must depend on the character of the plants and the land. Hay on tillage land usually consists of pure clover or a mixture of grass and clover. If clover be absent or very scarce it may be disregarded, and attention be wholly directed to stimulating the grass. In this case nitrogen in some form will be the main fertilising element. Thus, on an ordinary loam or clay, 1 to 1½ or even 2 cwt. of sulphate of ammonia or nitrate of soda—applied, in the case of the larger dressings, in two doses—will generally suffice. On light and peaty soils, a little superphosphate and kainit (say 2 cwt. of each) may be used. Rotation hay in Scotland, composed largely of rye grasses, has been found to respond particularly well to liquid manure applied at the rate of about 2,000 gal. (9 tons, approximately) per acre.

Where there is a good "take" of clover the nitrogenous dressing must be much curtailed or the clover will be smothered by the luxuriant growth of grass, and the aftermath is likely to be poor. On the other hand, phosphates and potash become of relatively greater importance. With a fair take of clover, ¾-1 cwt. of sulphate of ammonia or nitrate of soda, 2 cwt. of superphosphate, and 2 cwt. of kainit is likely to prove suitable; while with a strong and abundant clover plant the nitrogenous manure may be reduced by half, or even omitted, while the kainit may be nearly doubled, and the phosphates should be increased by the use of about 3 cwt.

of basic slag applied early in autumn. A slag of high citric solubility is generally to be preferred to one of low solubility, particularly in districts of low rainfall.

Lime may also be conveniently applied to young "seeds" in autumn, after the oat crop has been removed; 10 cwt. per acre of ground lime on light soils and at least 1 ton per acre on heavy soils would be suitable dressings where the land is in need of lime.

"*Seeds*" *Hay Aftermath.*—Where the "seeds" have not been manured, it may be desirable to top-dress the aftermath. In such cases from ½ to ¾ cwt. sulphate of ammonia or ¾ to 1 cwt. nitrate of soda, together with 2 cwt. superphosphate, will generally prove suitable.

Meadow Hay.

When a crop of hay is carted off the farm almost as much plant food is removed from the soil as in the case of a corn crop; hence the need for continuous and liberal manuring if the meadow is to be kept from deteriorating.

To obtain a great bulk of hay the object must be to produce as large a proportion as possible of the larger grasses and clovers, if any, in the herbage.

Liming.—Meadow land, especially that in low-lying situations, or on soils of a peaty nature, or that which has been continuously given farmyard manure or sulphate of ammonia, may be in need of liming. Lime may be applied in the form of ground quicklime, slaked lime, or ground limestone, whichever is cheapest, due regard, of course, being paid to the quality of the material. It is not good practice to repeat the dressing too soon, and the improvement resulting from the first application should be followed up by manuring.

Manurial Treatment.—Medium grass land under meadow hay should, if possible, get about 10-12 tons of dung per acre applied in autumn. Dung in amounts similar to this applied *every year* has produced heavy crops on light sandy land at Garforth and on poor clay at Cockle Park, and where dung is plentiful this practice may be usefully followed. Dung, with artificials in alternate years, has proved profitable on both light and heavy soils in practically all experiments carried out on this plan. The artificials used in alternate years have been nitrate of soda only (1½ cwt. per acre) or nitrate of soda and superphosphate (2 cwt. per acre) on light soils, or nitrate of soda, superphosphate as above, and kainit (3 cwt. per acre) on both light and heavy soils. Dung applied

every fourth year with artificials in the intervening years has also well repaid the cost of treatment on gravel, loam and clay soils. The artificials used in the intervening years may be 2½ cwt. of superphosphate or 3 cwt. of basic slag per acre applied in autumn and 1 cwt. of nitrate of soda per acre applied in spring, though in many cases the slag or superphosphate need only be used every second year. These quantities may be reduced if the aftermath is grazed by stock getting cake. Potash manures may also be applied in intervening years (say 2 cwt. kainit, or ½ cwt. sulphate or muriate of potash per acre), but in general it may be said that the farmer should determine by field trials whether potash should be used, as it is often unnecessary.

The value of liquid manure for meadow hay has been brought out by experiments in Ireland, both in wet and dry seasons. The quantity used has been 16 tons both alone and in combination with artificials. In addition to increased crops of hay the liquid manure induces earlier growth and stimulates the growth of clover. It would probably be best to apply the dressing at different times during the winter months, going over each part of the area two or three times.

Manurial Treatment without Dung on "Slag" Land.—Where dung is not available for meadows the treatment should be materially different. If the land is found to respond to basic slag it should get a liberal dressing (up to half a ton per acre) in autumn, and for the next two or three years—that is to say, till the clover begins to fail—nothing more need be given. After that time attention should be given to forcing grass, as distinguished from clover, and this may be done by annually using about 1 cwt. nitrate of soda per acre. After two or three years of such treatment—that is to say, five or six years after applying the slag—the land will again be in a condition to grow clover luxuriantly, when a liberal dressing of slag (say 6–8 cwt. per acre) and 4 cwt. kainit should be given, followed in subsequent years by nitrate of soda as before.

Manurial Treatment without Dung on other Land.—If the land is not of the character that responds to slag, the treatment should consist of annual dressings of a general mixture of artificials. Potash and phosphates will increase the leguminous herbage, giving feeding value, while nitrogenous manures will encourage the grasses, producing bulk. Further, a complete dressing of artificials will depress the weeds (a fact which is perhaps to be ascribed to the sulphate of ammonia

and superphosphate), while repeated dressings of dung, only, tend to encourage the coarser grasses and weeds.

In the numerous experiments which have been carried out on the manuring of meadow hay, complete dressings of artificials have given consistently good results on all classes of soil. The quantities used have been: 2–5 cwt. of either superphosphate or basic slag; 2–3 cwt. of kainit or 1 cwt. of sulphate or muriate of potash; and about 1–2 cwt. of nitrate of soda or sulphate of ammonia.

As regards incomplete dressings of artificials it is interesting to note, in view of the present dearth of potash, that combinations of nitrate and phosphate have given good results in nearly every experiment where tried.

Manures that contain only nitrogen, however successful at first, if continued, result eventually in deterioration of hay; the same is often true of manures containing phosphates only.

Pasture.

Manuring on Formation of Pasture.—In forming permanent pastures it will seldom be advisable to apply nitrogenous manures either just before or immediately after sowing the seeds. The first effect of the manuring would be to increase the quantity of straw produced by the corn crop with which the seeds have been sown, and thus to repress rather than aid the young pasture plants. Phosphatic manures, such as basic slag or superphosphate, on the other hand, should be used liberally, and may perhaps be best applied to the preceding root crop. If the root crop has not received either of these artificial manures, one or other may be worked into the land before sowing the seeds. In dry districts and on light soils, 3–5 cwt. of superphosphate should be applied in spring, but for most soils, 4–6 cwt. of basic slag may be recommended. This manure may be applied at any time between November and March, when the soil is in suitable condition. If farmyard manure has been used freely (12–15 tons per acre) for the root crop, and if part of this crop has been consumed on the land, a potash manure may usually be dispensed with; and even where roots have been carted off, potash manures are not likely to be required before sowing, except on light gravelly, or on light peaty soils.

Six to nine months after sowing the seeds, light soils should receive from 3 to 5 cwt. of superphosphate, and from 2 to 4 cwt. of kainit per acre; and these manures, in quantities varying with the condition of the herbage, must be repeated at intervals

of from two to three years until the pasture becomes established. Nitrogenous manures may also be employed with advantage under certain conditions, but to use them successfully on pastures, a farmer must be well acquainted with their properties, and their general use is not to be recommended. A dressing of from 7 to 10 tons of farmyard manure two or three years after sowing down a pasture would usually prove very beneficial.

Established Pastures.

Improved Pasture.—On rich old pastures no nitrogenous manuring will be needed as the soil will become richer in nitrogen every year. Where cake and corn are fed, organic matter has probably accumulated; in such cases, lime and phosphates may be deficient and occasional dressings of ground lime (1 ton per acre) and basic slag (5 cwt. per acre) will therefore be of value.

Much good grass land has slowly deteriorated chiefly as a result of impaired aeration caused by winter puddling by stock; in this case the land should be limed and the toothed harrow used.

Unimproved Pastures.—There are large areas of pasture in this country of a kind that experiments and practice alike have shown to be capable of easy and practicable improvement; they can be made to carry double their present stock and each animal will produce much more meat in a grazing season. Examination of the herbage on the best grazing land has shown that it is composed largely of white clover and rye grass and that high quality is associated with a soil rich in available phosphate; experience has shown that the improvement of much inferior pasture may be brought about by phosphatic manuring (sometimes with the addition of potash).

Basic slag usually gives its most striking result when applied to poor pasture on heavy clay soil. The alkalinity of the slag renders it also a very suitable manure for peaty and sour soils. Even very light soils deficient in lime sometimes respond well to an application of slag. The success of basic slag is dependent on a number of well-recognised factors, such as the presence—it may be suppressed—of white clover, and space for the clover or other plant to spread; these conditions usually occur on land covered with bent. A dense turf of miscellaneous herbage militates against the success of basic slag. On poor pastures white clover is usually present, though not apparent, because it may be small and dwarfed. If there is no white clover a little (say 1 lb. of wild white) should be harrowed in in autumn or early spring after manuring.

Basic slag is most suitably applied in autumn or early winter; very good results have, however, followed July application; harrowing the land before applying the slag is sometimes advisable. The slag may be expected to prove more profitable if a large dressing (say ½ ton) is given at the outset and repeated after six years than if ¼ ton is given at first and a further ¼ ton after three years. The effects of the heavy dressing will be found to last for many years. A repeated dressing of basic slag has, however, a marked effect in some cases, and the productivity of slagged pastures that are showing signs of exhaustion can be quickly improved in this way; the action of a repeated dressing appears to be more rapid in many cases than the action of the first dressing.

Although not so suitable for light soils as for clay, such soils, especially chalky soils, have benefited materially from dressings of basic slag. On light soils, in addition to trying slag alone, the effect of adding kainit when available (at the rate of 3 or 4 cwt. per acre) might be tested. Potash is seldom required on heavy clays, but may be needed just as much as phosphate on light soils.

Only if an "early bite" for lambs or cows in spring is of great importance should nitrogenous manures be given; liquid manure would probably be most suitable for the purpose as it has a less detrimental effect on clover than other nitrogenous manures, but the latest dressing would have to be given some weeks before the stock are to be turned on to the grass so that all trace of the manure and its smell would have had time to disappear. No nitrogenous manures at all should be given at the outset in improving poor pastures by the use of basic slag, nor should cake-feeding be resorted to; nitrogenous manuring in such cases is a bad practice: it tends to encourage the inferior grasses and to suppress what little white clover is present, and the value is never recovered. It is impossible, however, to maintain a purely leguminous herbage, and clovers will partly disappear in the course of three or four years, being replaced by grasses; this is due to the fact that the nitrogen accumulated by the roots encourages the growth of grasses. Further, a mixed herbage is desirable from the grazier's standpoint. From the third or fourth year onwards, therefore, when the slag will probably have produced its maximum effect on the clovers, cake may be given to stock, or dung or artificials supplying nitrogen applied.

A fairly common cause of the failure of basic slag to improve pasture is the closeness or coarseness of the herbage present.

In such cases the following might be tried: (1) Mowing the roughage, followed by a dressing of nitrate of soda, which will encourage cattle to graze the young growth closely; or (2) mowing, followed by close grazing with cattle, and the application of lime in addition to basic slag.

Although inferior to basic slag on the heavier soils, on lighter and drier soils more certain results may be obtained from the use of superphosphate, and under such conditions the addition of kainit, where available, is recommended—say 3 cwt. of superphosphate and 2 or 3 cwt. kainit applied every three years; and if the land is unsuitable for the spread of white clover, cake could be used during the latter part of each season.

Chalky Soils.—On some of the Downs a dressing of 8 or 10 cwt. per acre of basic slag has had a most marked effect in improving the herbage. On lesser areas dung, combined with cake-feeding and followed by the use of a complete dressing of artificials, may be recommended.

Peaty or Moor Soils.—Soils rich in organic matter respond well to dressings of finely-ground raw mineral phosphate, particularly where the rainfall is abundant. An adequate supply of water, in conjunction with the carbonic acid always occurring in such soils, helps to render the phosphate available for plant growth. Under such conditions ground mineral phosphate is well worth attention at the present time.

It appears that excessive acidity and excessive alkalinity are both destructive of moss. Lime is known to eradicate moss on some soils; superphosphate or basic slag and kainit, particularly the first-named, has also had good effects. "Fogging" is also recommended—*i.e.*, allowing foggage to stand through the autumn for winter grazing; a practice followed in districts with a mild winter—*e.g.*, Wales and S.W. England.

NOTES ON BREAKING UP GRASS LAND.

THE preliminary statement on the Agricultural Returns, which will be found on page 596, shows that in the past year farmers have added largely to the area under wheat and oats, but the increase in these corn crops has been secured mainly at the expense of other crops occupying ploughed land; very small additions appear to have been made by ploughing up permanent and rotation grasses.

In the harvest year now beginning, the country expects farmers and farm labourers who have not joined the army to take their share in the burden of war by using their utmost efforts to produce more food; and farmers in most parts of England and Wales, conscious of this duty, are now considering the possibility of ploughing up inferior grass land with the object of increasing its productiveness.

Attention will, in the first instance, doubtless, be given to rotation grass that has been lying out for some years. The tillage of this land should present few difficulties; much of it might at once be prepared for wheat and most of it for oats. In the next place the choice should fall on second-rate grazing land of medium texture. Land of this kind may be profitable enough in a favourable grazing year, but there is much of it, carrying little stock in a cold or dry summer, which would be better ploughed. Again, there are many fields that make unprofitable pastures in dry years because of the lack of a good supply of water for stock. These might now be ploughed up. Light, sandy soils which have been allowed to lie out in grass because too poor to cultivate will next claim attention. The difficulty in dealing satisfactorily with such soils at the present time is the scarcity of artificial potash manures. This restricts the choice of crops. But as soils of this kind are of very small value when under grass, they might be ploughed and sown early in spring with oats, a crop which thrives very well in soils containing little potash. In the south, sandy soils should be ploughed before the end of November and sown before the end of January. The object must be to get the oat crop well established before the end of April, otherwise, should a spell of dry weather set in, the yield will be small. Another method of bringing sandy soils under arable cultivation would be to grow vetches, rape or turnips and consume the crop on the land. Downs with a tolerably deep soil, and adjoining land already in cultivation, might, in some instances, be brought under the plough. In former times the first crops sown on such land were turnips, vetches, or other green crop for sheep-feeding, after which wheat or some other corn crop was taken. Where the surface is flinty or gravelly, the land may be ploughed, pressed and sown with oats.

The most difficult and perhaps the most important class of soil with which the farmer has to deal is the heavy land formerly under wheat, but now producing grass of the poorest quality. This is the type of pasture which, because of the certainty with which it can be improved by the use of basic slag, is

often referred to as "slag" land. The first point that arises in tackling pasture of this description is the drainage. Assuming the old drains to be in working order, and the labour to be available, a proportion of the land might be taken in hand at once; the remainder should get 8–10 cwt. basic slag per acre,* and should have the drains attended to, with a view to ploughing in a later year if circumstances point to the desirability of putting it again under wheat.

Land that is damp and sour should not be broken up until after it has been drained, but there are many peaty soils growing grass of little value which could be turned into useful arable land if properly drained, limed and manured. Like sandy soils, peaty land usually requires potash.

Damp patches frequently occur in grass fields which are otherwise suitable for breaking. In these cases the broken drains may be repaired during the winter, and the ploughing of the wet land deferred until spring, but the remainder of the field should be ploughed as soon as convenient. The turf in the wet spots, if peaty in character, would not rot well if ploughed in, and under these conditions the practice of paring and burning might be resorted to. There are some grass districts where the practice of paring and burning was once very common, and where it might usefully be revived for the purpose of dealing with a thick, untractable sod. It is carried out as follows: Paring starts in February so that the turf may be exposed to the drying winds of March. On a small scale the turf is pared off by a hand tool, but on a large scale by means of a plough fitted with a winged share. The dried turf should be collected and burnt in small heaps, and directly the heaps are charred through the ashes should be evenly distributed. It is undesirable to wait till the ashes are cold, or combustion will proceed too far and a great proportion of the vegetable matter will be lost. Black ashes are better than red. The fires burn more slowly and require more attention in damp weather, but better ashes are then made. If the land is sticky and close in texture a proportion of the soil may usefully be burnt with the turf, so improving its physical condition and adding to the store of soluble plant food. Further, burning kills plant pests, destroys roots and seeds of weeds, and facilitates the formation of a compact seed bed so essential for the growth of wheat. The ashes

* Very rarely slag has no effect on this type of land because no clover plants are present. If no clover can be detected advice should be sought. (See Special Leaflet No. 25, *Technical Advice for Farmers.*)

should be ploughed under with a shallow furrow, after which the surface should be well harrowed and rolled.

In ploughing up old turf it is essential to cover it well, and at the same time to expose the furrow slice very fully to the air. This may best be done by setting the plough irons so that a crested furrow is formed instead of the usual rectangular furrow. If the crested furrow is thoroughly pressed home, and if the upturned soil is exposed to one or two sharp frosts during the winter, there will be little difficulty in getting a satisfactory seed bed for oats. In the following year the land will be in good condition for potatoes, or a second (manured) oat crop might be taken.

In those parts of the country where a sufficient amount of frost cannot be depended upon, or when for any reason oat-growing may not be desirable, the first crop may be selected from the following list: Potatoes, peas, beans, rape, white mustard, vetches, or a mixture of vetches and corn and, in some cases, turnips. The four last-named crops may be sown broadcast, if necessary, the ground being afterwards lightly chain-harrowed and consolidated by the Cambridge roller. On impoverished land such crops are specially valuable, as they may be fed off with sheep before taking a winter corn crop. White mustard sown in spring will be ready for use in from 6 to 8 weeks, and may be followed by rape, while early-sown rape will afford at least two grazings before late autumn.

Potatoes will do well as a first crop if care be taken to select a strong-growing variety and to get "seed" grown in a northern climate. Under no circumstances can potatoes be grown more cheaply, and with greater freedom from disease, than on a well-managed grass sod. Further, "seed" potatoes from a grass district, particularly an upland grass district, will afford an excellent change for warmer and drier localities.

Peas, whether of the field or garden type, will likewise give a good return on medium or light soils if weeds can be kept in check. Beans alone are uncertain; they frequently make good growth, but are apt to pod badly, and their open habit of growth encourages weeds. As a smother and preparatory crop there is nothing to surpass vetches, which may be sown either in autumn or spring with or without an admixture of corn.

In the foregoing notes the importance of thorough drainage has been referred to. It is further necessary to remember

that land which has for long been left uncultivated and has, in consequence, accumulated considerable stores of organic matter, is almost sure to be deficient in lime. Potatoes and oats are less injured by sourness in the soil than most other crops, but the best results with any crop will be attained only when, by the use of lime, a neutral condition is brought about. Where the land shows indications of sourness moderately large dressings of lime or chalk, say from 1 to 2 tons of the former or 15–20 loads of the latter per acre, should be applied. (See also Leaflet No. 170.—*The Use of Lime in Agriculture.*)

The present deficiency in the supply of artificial potash manures will somewhat restrict the successful cultivation of the lighter soils, but this difficulty may be partially met by growing oats as already suggested; by consuming the first crops on the land along with cake or other concentrated feeding-stuffs, and by dressing with dung or liquid manure where such are available. In this connection readers are referred to an article by Dr. E. J. Russell in this *Journal* for August, 1915, entitled, "How can Crops be Grown without Potash Manures next year?"

All second-rate and inferior grass land broken up for corn should be dressed with 2½ to 4 cwt. of superphosphate or basic slag per acre when the seed is sown, and, especially on cold, heavy soils and on light, hungry land, a nitrogenous manure in spring would be an advantage.

Further particulars in regard to the cultivation of most of the crops referred to in this leaflet will be found in Special Leaflet No. 28. (*Suggestions for the Cultivation of Catch Crops and Home-Grown Feeding-Stuffs.*)

THE WORK OF EDUCATED WOMEN IN HORTICULTURE AND AGRICULTURE.

MRS. ROLAND WILKINS.

THIS report is the outcome of an enquiry conducted on behalf of the Women's Farm and Garden Union, for the purpose of ascertaining what openings exist for educated women to take up some form of agricultural or horticultural work as a profession.

Owing to the war many more educated women than usual are faced with the prospect of having to earn their own living, and amongst them an appreciable number would prefer an outdoor life to a sedentary occupation in a town.

This question is a topical one, and will also remain permanent for this generation. There is at the moment, however, an even more immediate question which is of public interest, and is not confined to the educated class of women, namely, the provision of help to farmers in connection with keeping up the food supply. It is only from women that an increased supply of labour can now be obtained. However acute this question may become during the continuation of the war it is likely to diminish considerably in importance after the war; at the same time it is undoubtedly a question for all time. For instance, it is well known that the woman is an appreciable factor in the success of small holdings, and that a large amount of agricultural work is still done by women in the Northern Counties and in Scotland. The present need for women is simply a development of this. We have heard how much French women have contributed to the sowing and reaping of the harvest in their country: this work of the French women has been, in most cases, not a new work for which they required training, but merely an addition to their ordinary employment.

While confining our attention, therefore, to the possibilities of horticulture and agriculture as a profession for educated women, it is realised that this is a very small part of the big national question with which we are now confronted. It would be interesting to ascertain why in certain counties women still continue to take their place in agricultural work, whereas, in other counties the custom has completely died out. If the war continues long enough, women will undoubtedly play a more important part in such work, but will it continue after the war? What are the advantages of women doing agricultural work (*a*) to themselves, (*b*) to the country? These are questions one would like to see answered, but considerable time is needed for such a far-reaching enquiry, and it has been decided to keep this report within the limits of the original intention.

The information given in this report is based entirely on the accumulated evidence collected from a large number of those who have been engaged in the profession for years. Personal visits have been paid to 70 places where women are working holdings of their own; evidence has been received from several hundred women in salaried posts by circularising them with forms. An endeavour has been made to reproduce, without bias or prejudice, in a summarised form, the information and opinions given, and the statements made on many thorny

points must, therefore, not be regarded as merely an expression of personal opinion. The report is confined strictly to the experiences of the past, and no attempt has been made to discuss any of the many new openings which the war may have created.

INTRODUCTION.

To what extent have educated women already taken up the work on the land as a profession? In answering this question it is necessary to define very clearly what type of woman is under consideration.

Of the 94,000 females included in the 1911 census as employed in agriculture, 20,000 are under the heading "Farmers and Graziers," and 2,449 are classed as "Market Gardeners."

The majority of these are the female relatives of farmers and market gardeners carrying on their husbands' or fathers' profession, in which they themselves have doubtless been brought up, and with which they have been associated all their lives. Although, in matters of education, numbers of them doubtless merge into the same class as the women under consideration, they do not come within the scope of the present enquiry, which deals with women who, after a secondary education of a superior type, wish to enter this profession from the outside.

It is probable that in all times there have been isolated cases of educated women who have struck out a line for themselves in this direction; but the definite entry of the professional woman into this industry dates from the year 1892, when the foundation of Swanley and later Studley as separate Horticultural Colleges for women afforded opportunities for instruction in horticulture. These colleges were, and are still, largely attended by town girls, and the profession has, undoubtedly, attracted a number of women who, although brought up in different surroundings, prefer an open air life, and find healthy and congenial work as gardeners, or, where capital is available, in setting up for themselves on small holdings, market gardens, fruit farms, poultry farms, etc. The question it is desired to answer is: To what degree have they been successful, and how far are the results encouraging, or otherwise, to those who wish to adopt this career as a profession? An attempt has been made to arrive at an answer by circularising old students, with a view to ascertaining the numbers employed, the rates of pay, the nature of the posts filled, how many have set up for themselves, and under what conditions. A considerable number of those

who have holdings of their own have also been visited. This survey has not been comprehensive, partly owing to the difficulty of tracing old students where no records are kept at the training centres, and partly owing to the limited time in which it was carried out. The particulars given throughout the report should not, therefore, be regarded as the result of a complete and exhaustive enquiry, but only as an indication of the possible results obtainable, as illustrated by the cases of those whose careers have been traced.

The report is divided into parts as follows :—

Part 1.—HORTICULTURE. (*a*) *Training*: Where to train; length of training; cost. (*b*) *Results*. Being a survey of the work already accomplished by women.

Part 2.—AGRICULTURE. (*a*) Training. (*b*) Prospects.

Part 3.—GENERAL SUMMARY OF PROSPECTS.

1. HORTICULTURE.

(*a*) *Training*.

Whether a woman intends to seek a salaried post as gardener or to set up for herself in a commercial garden, she is entering into competition with men who have probably served their apprenticeship from the age of 14, and have had life-long experience in their profession. The average woman, if she be a complete novice, or even one who has gained some knowledge of gardening in the private garden of her own home, cannot hope in the course of a year or so to be as well qualified as the man who has been doing nothing else all his life. It does not necessarily follow that the educated woman must go through the same long years of apprenticeship to attain the same degree of success; a good, sound, general education and a quicker intelligence will compensate fully for a shorter apprenticeship in early life; but the fact remains that experience in the practical side must be attained through a course of years with varying seasons and varying conditions. The majority of men gardeners get their training in private or commercial gardens, either receiving a low wage as under-gardeners, or as improvers, or, in the case of commercial gardens, paying a premium and receiving a few shillings a week. They can also get instruction at the gardens of the Royal Horticultural Society, and at some of the institutions in connection with County Councils.

In the case of women, they have so far been practically debarred from gaining instruction in commercial gardens, where employers, as a rule, do not care to admit them; it

is possible that these circumstances may alter now that war conditions have necessitated the entry of women into new forms of employment. The consideration of the horticultural training of women raises so many vexed questions, that it is not proposed to enter into it here. One fact, which stands out clearly, is that without lowering the standard of training it is not possible to provide all the kinds of instruction required in one institution. Different types of institution are required according as the object in view is the serious training of women for the colonies, for gardening posts at home, for the training of teachers in gardening, or whether the institution is to form a finishing school.

Where Training can be Obtained.—There are three types of training centres for women in horticulture, viz. :—

(A) Collegiate Institutions and County Council Centres.

(B) Gardening Schools.

(C) Various Private and Commercial Gardens run by ladies.

A. *Collegiate Institutions and County Council Centres.*—The object of these institutions is to give a broad, general, horticultural education. Speaking generally, they have a definite staff of lecturers and demonstrators ; the theoretical side, as taught in lectures, is as fully developed as the practical ; waste, due to the spoiling of plants by the work of inexperienced students, is recognised as a necessary factor in practical instruction, and allowed for at the expense of the commercial side.

B. *Gardening Schools.*—These are of such a varied type that it seems almost impossible to put them together in one class, but, speaking very generally, they are, with one or two exceptions, carried out on a smaller scale than the Collegiate Institutions, both as regards staff and extent. The practical side predominates definitely over the theoretical ; where the commercial aspect is a feature, it is less possible to allow students to spoil plants and fruit trees ; and each school has its distinct characteristic, whether it be French gardening, colonial training, small holding cultivation, private gardening, nature study, or adaptation to the needs of delicate girls.

C. *Private and Commercial Gardens run by Ladies.*—There is a third type of training centre which merges so closely into some of the smaller institutions of the last category that it is difficult to draw the line between them. These are semi-commercial gardens on a small scale where pupils are taken. No doubt in many cases the advantages to pupil

and employer are mutual, and endeavours are conscientiously made to allow the pupils to practise even though they may do a certain amount of damage. The fact remains, however, that the pupils are there fundamentally to help, by their fees, the financial side of the enterprise; in some cases the training obtained may be well adapted to the pupils' individual requirements, and therefore more suitable than that obtained in a regular institution; in other cases it may be merely a waste of time and money for a girl to be there.

Deciding where to Train.—In deciding, therefore, what training centre to attend, a girl should make herself thoroughly acquainted with the exact scope of each place, and consider what it will enable her to undertake at the end of her training. If she can give a definite answer to the following series of questions she will then be in a better position to decide what course of training it is best to adopt, and which place best provides for her individual requirements :—

(1) What length of training can I afford?
(2) Do I intend to try it for a short time to see whether I like it or not, or
(3) Because I have been advised for reasons of health to lead an outdoor life?
(4) Do I mean to take it up seriously as a profession by which to earn my living, or in order to supplement a small income?
(5) In this case (4) is it absolutely essential that I should at once begin to earn my living on the completion of 1, 2, or 3 years' training?
(6) Or shall I have enough to live on while gaining further experience as improver or under-gardener at a low wage?
(7) Do I want to qualify as a gardener on a large private place, or go as companion gardener on a small place, or work on a commercial garden, or teach gardening?
(8) Or do I, having a small capital or private income, hope to start an enterprise of my own?

Length of Training.—The regular courses of training provided at the larger institutions are from 1 to 3 years in length. It is not advisable to take a course of less than 2 years, but it is questionable whether, if a third year of training is possible, it is not best to take it at some other place, in order to obtain a more varied experience, not only in methods, but of soil and climatic conditions, or to specialise in some particular branch.

The larger part of the failures that have occurred in this profession are due to the fact that students are too apt at the end of a 2 or 3 years' training to think themselves qualified to take up any post that offers itself. Whether this attitude

of mind is due to such a fault in the methods of the teaching that at the end of a course students are unaware of their inexperience, or whether it arises out of the mere optimism of youth, is an arguable point, but the tendency undoubtedly exists, and harm often results. Girls leave these institutions to compete largely with men who have had a life-long practical experience; they would be well advised, if they wish to qualify for the higher posts, to be content to widen their experience and continue their training, by first obtaining posts in good gardens as improvers or under-gardeners at a low wage.

Age at which to Train.—It appears to be generally advocated that girls should not begin training too early; they are not as strong at 16 as they are likely to be a few years later, while there is difficulty in placing very young girls over men, or in finding them posts as under-gardeners. The loneliness of the life in many private establishments would also affect young girls more than older women. One woman who was a head-gardener at 20, with three under-gardeners, advises that the training should begin at 17, and the general opinion would confirm this as being the earliest desirable age; many put it as late as 20.

Cost of Training.—At the collegiate institutions the fees are from £60 to £150 inclusive (according to whether the accommodation is a cubicle or a study-bedroom), for 3 terms of 13 weeks.

The County Council Centres charge from 10*s.* to 15*s.* a week for instruction to non-residents in the county; board and lodging can usually be obtained at about 12*s.* 6*d.* a week.

Most of the schools charge 80 guineas inclusive for 3 terms of 13 or 14 weeks. Lower terms can often be arranged by girls sharing rooms. Some of the smaller places, taking a few pupils, charge from 50 guineas inclusive.

The lengths of the terms vary for the inclusive prices; some institutions have three regular terms; others give a month's holiday in the year at different times so that all the pupils are not away at once.

The tabulated statement given on p. 561 shows the principal points concerning the better-known establishments in England taking 10 students or more, as shown in their published prospectuses.

(b) Results.

The question whether a girl, after training, has started on an enterprise of her own, or has taken a salaried post,

Name	Establishment.	Extent of Garden in acres.	Horticultural Instructors.	Cost. Tuition.	Cost. Board.	Extras.	Number of Students.	Length of Terms.	Length of Full Course.
Colleges									
Horticultural College, Swanley, Kent	1892	10 garden, 25 fruit.	5 4 visiting lecturers.	£40 £70 to £120. Short courses, £26 (10 weeks). Teachers' holiday course, £5 5s. (2 weeks).	—	Dairying, £3 3s. Poultry, £3 3s. Beekeeping £2 2s.	80	3 terms of 13 weeks.	2 years' diploma. 2 years' certificate
Horticultural College, Studley, Warwickshire	1898	40	5	£60 to £150. Short courses 2½–4 guineas a week.		Beekeeping £5 5s. Carpentering, £2 2s. Laundry, £2 2s. a term.	50 to 60	3 terms of 13 weeks.	3 years' diploma. 2 years' certificate
University College, Reading	—	4 garden, 11 fruit.	1	£18 to £24 for 40 weeks.	£32 to £42 for session of 30 weeks.	Examination Fee, £1 1s.	13	—	2 years' diploma. 1 year certificate
County Council Centres									
Horticultural School, Lancashire C. C. Farm, Hutton.	—	4	2	County Students free, others 10s. a week.		—	—	—	1 year.
East Anglian School of Agriculture, Chelmsford	1895	3	2 4 lecturers.	Essex County free, others 15s. a week.	*Outside lodgings* at 12s. 6d. a week.	—	15	3 terms of 3 weeks 1 term of 4 weeks	13 weeks. The 4 short courses make 1 year's full course.
Schools taking over 10 pupils									
Arlesey House, Hitchin	1908	4	2	80 guineas.		—	12	—	2 years.
School of Nature Study and Gardening, Clapham, Worthing.	—	3	3	£13 6s 8d per term	£80 to £120.	Microscopes, 5s. a term.	24	—	2 years.
Elmwood Nurseries, Cosham	1902	4½	2	£60		—	10	—	—
Glynde College for Lady Gardeners, Nr. Lewes.	1901–2	5½	1 visiting lecturer.	£18 per annum £20 per annum	*About £1 a week*	Expert's lectures compulsory, £6 *per annum*.	20	1 month's holiday in the year and half holiday a week.	2 years.
Greenway Court, Hollingbourne	—	6 market garden, 1 fruit, 15 orchard.	2	80 guineas.		—	12 to 14	year of 40 weeks.	1–2 years.
St. James Gardens, West Malvern	1912	20	2	30 guineas a term. 25 guineas sharing room. 13 guineas.	—	—	12	3 terms of 13 weeks	2 years.
Devonshire School of Gardening, Tonbridge.	1911	5	3	£18 per annum, 10s. 6d. a week.	From 70 *guineas*	3 guineas a term for those staying under 1 year.	12	3 terms of 13 weeks	2–3 years.
Royal Botanic Gardens, London	—	18	2	1st year £20. 2nd year £15. 3rd year £10.	Non-residential.	Floral decoration £1 1s.	—	—	3 years.
French Gardens, Stonehouse	1913	5	2	£65 to £84.	£6 10s. to £8 a month.	—	10	—	—
Thatcham Fruit and Flower Farm, Newbury	—	8	4 outside	£12 16s. a term.	80 guineas.	—	20	3 terms of 13 weeks.	2 years.

appears to have been mainly a question of capital. Those without private means, who have their living to earn, have had of necessity to adopt the latter course; others, who have had a small sum to invest, or whose parents have been able to start them in a career, occasionally set up for themselves. In almost every case two women have set up together. A brief indication of the general results obtained is given under the two headings "*Own Holdings*" and "*Salaried Posts.*"

(i.) OWN HOLDINGS.—Particulars have been obtained of, or visits paid to, 43 women with horticultural holdings. Of the 43:—

(i.) 18 have various forms of market or nursery gardens;
(ii.) 8 have small holdings where gardening predominates;
(iii.) 4 are carrying on the gardens at their homes on a commercial basis;
(iv.) 3 have jobbing businesses (not connected with nurseries);
(v.) 4 have private gardening schools (apart from those with a commercial aspect which are included under (i.));
(vi.) 1 is specialising in seed growing;
(vii.) 5 have given up owing to want of capital, or through not being successful for want of business habits. Four of these had small market gardens and one had a gardening school.

There are a considerable number of others who live at home and sell the surplus stuff out of their private gardens, or save the cost of keeping a gardener.

Market and Nursery Gardens.—This form of holding appears to be the one most generally adopted, but it varies considerably in type. In some the market side predominates, ranging from the growth of the ordinary market crops to specialisation in certain branches only; two women specialised in carnations, one in violets, one in flowers generally, and two went in very largely for French gardening. In others the holding might be worked more as a nursery, and here, again, it might be on general lines, or a special side such as hardy plants, might be developed. In several cases nurseries were combined with a jobbing business and landscape gardening. In others, pupils were taken in sufficiently large numbers to make it worth while developing the educational side, and they were carried on definitely as horticultural schools—where commercial as well as private gardening was taught.

It is not possible, in a short report of this nature, to describe the different types of cultivation adopted, and the technical methods practised. The varying degree of success appeared to bear less relation to the particular branch adopted than it did to

the capacity of the person adopting it. It required common sense, experience, and a business mind to decide what branch was best suited to the given locality, or to choose a locality most suitable for the branch of horticulture to be adopted. For instance, one girl started growing chiefly flowers; but she found that in her neighbourhood there was a universal demand for vegetables, owing to the existence of a large number of houses with small gardens whose owners preferred keeping them as pleasure gardens, and buying vegetables; so she changed her methods to suit these conditions. Another started a market and nursery garden in a district where there was no room for general nursery work, and so took to specialising in certain varieties. Again, those who have not much capital to invest must not choose a type of garden which requires a large amount of glass, or a locality in which the price of land is prohibitive.

Extent of Holdings, Rent, etc.—The bulk of the holdings were from 2 to 5 acres in extent. The smallest was 1 acre, and the largest 20 acres. The very small ones were in urban areas, where the price paid for land amounted to building site value; the chief business here would be the sale of hot-house plants, fruit, and cut flowers, and there would be a corresponding amount of glass. The larger holdings were in country districts where land is cheaper, and the cultivation would include more vegetables and fruit.

In quite a number of cases the freehold had been acquired, and sums varying from £85 to £500 an acre paid for it. Where the land was leased the rent was from £1 10*s.* to £5 an acre. In nearly every case the price paid was for a bare field.

Disposal of Produce.—This was nearly always largely on local or private lines. Only those who specialised in particular varieties, or who grew any one crop on an extensive scale, appeared to use Covent Garden and the other wholesale markets to any extent. It was this business side which appeared to be often the stumbling-block. The growing might present no difficulties; but the right thing to grow, and how best to dispose of it, was the chief problem, and that in which mistakes at the outset were most often made.

Capital Invested.—A considerable number of holdings have been started with a capital of from £200 to £300, and their owners are living partly on small private incomes. The highest amount in the figures supplied is £1,950, but several successful women had started with from £500 to £1,200, and

one or two are now making an entire living. Some figures have been supplied in answer to a request to be informed of the initial cost of starting in individual cases, and may be useful in giving an idea of the nature of these expenses :—

	£	s.	d.
A.—3½ acres of land	297	10	0
Fencing	60	0	0
200 ft. run of glass houses (heated) .. 100 ft. frames (heated) .. 100 ,, (cold) .. 2 tool and packing sheds	342	0	0
Expenses of first two years (largely stock) about	500	0	0
	£1,199	10	0

The third year the profit was approximately £50 exclusive of living expenses, and apart from the fact that the place was growing in value as the fruit trees developed, etc.

	£
B.—Land and House	1,050
3 glass houses, 75 ft. × 12 ft. .. .. 1 glass house, 35 ft. × 20 ft.	350
Sheds and other sundries	50
Working expenses	500
	£1,950

During the first two years the produce sold amounted to £335, and the stock on hand at the end of the second year represented a value of £349; wages, coal, stock bought, etc., during this time amounted to £628.

Examples.—The following are examples of some of the enterprises :—" X " and her two sisters have built up a large nursery business near a town on the South Coast. The eldest sister was trained for two years at a horticultural institution and then taught the two others; one of these had also a year's work as florist in a commercial nursery in the North. The girls were given £1,000 to start with. They took a 4-acre field and laid it out from the beginning, keeping themselves on the money as well. After two years they made it pay sufficiently to keep themselves entirely with the help of a dress allowance. The £1,000, therefore, was sufficient to set up the three sisters and train two of them. They have now been going 14 years, and have put up 250 ft. of glass, representing an outlay of £420, of which only about £120 came out of the capital.

The business was started as a market garden, but after a few years the sisters worked it on different lines, and gradually

built up a school and nursery. Produce is disposed of in the neighbouring town and a van is kept for the purpose. The nursery stock is mostly used for landscape work undertaken in the autumn, the remainder being sold locally. Besides the nursery work other crops are grown for the instruction of students. Some of the land is planted with all kinds of fruit and sufficient vegetables for purely educational purposes. There is also a small rock garden, a rose garden, and herbaceous borders. The garden, as it is, pays well, apart from the students' fees, and the owners consider it could be made far more profitable as a separate concern if only a few crops were grown.

"Y" had two years' training at a gardening school, and spent one year as improver and marketer. She and her sister then started on a bare acre of land near a small country town in the southern counties. They have now been going 5 years, and possess two fair-sized glass houses, two sheds, about 200 cloches, frames, and garden lights. Half an acre is planted with apples, black currants, and strawberries, and quarter of an acre is devoted to bulbs. They have a few herbaceous plants, and go in largely for rock plants. Under glass they grow chiefly chrysanthemums, tomatoes, and violets.

As the only available capital at the outset was £140, all the stock has been built up out of the actual proceeds of the holding itself during the 5 years, and now represents a capital value of some £600. Board and lodging during this period were provided in return for the care of a smaller private garden adjoining, and the supply of vegetables to a private house. As regards disposal of produce, the chrysanthemums are sold retail locally, and wholesale in a neighbouring town. The tomatoes, of which about 1 ton was grown last year, are sold in local shops. A good private connection has been built up for violets, which do exceedingly well, and of which over 1,000 a day have been picked. The labour has been done almost entirely by the sisters, with the help of one or two occasional students.

Amount of Success achieved.—It must be remembered that nearly all these undertakings are the outcome of a training which was only instituted some 13 years ago; very few have been going for more than 7 or 8 years, and a great many only 4 or 5. In almost every case the garden has been made from a bare field, and the initial capital invested has been high,

especially where much glass has been put up. It takes at least three years before the land is fully developed and a connection is established, and it may be much longer with bad seasons, or initial mistakes on the business side.

It is difficult to define precisely the amount of success which has been attained; it is putting it at its highest to say that some are making a living, but not many are making money. The majority are supplementing a small income. At one end of the scale we find a woman, starting with £1,000, who, after 23 years, has trebled the capital entirely out of the proceeds of the holding, and is making a profit on it of 11 per cent. At the other end we find women giving up after two or three years, owing to their having started with insufficient experience and too little capital, the consequence often being a breakdown from over-work and worry. Between these two extremes we find women who have attained varying degrees of success.

Causes of Success.—The opinions collected, either from personal visits or by correspondence, are unanimous in regard to the general causes of success and failure. The successes are stated to be due to (1) good health, or (2) good business capacity, or (3) sufficiency of capital, or (4) a thorough training on the practical side. The writer says "or" advisedly, for there have been successes when possibly only one or two of these factors exist—*e.g.*, one of the most successful enterprises was run by a woman who was extremely delicate and unfitted for hard work before taking to an outdoor life, but who has succeeded with a small capital through sheer business capacity. Another very successful woman had had no training, but was strong, and business-like, and lucky in her employees; a good foreman, coupled with her own individual capacity, compensated for her initial lack of knowledge. Many people rely too much on the fact that they have been trained, and do not realise that training does not altogether make up for want of common sense and business habits.

Causes of Failure.—The failures are all due to very definite causes, viz.:—

1. *Insufficiency of capital*, resulting in not being able to withstand a few bad seasons; in not putting sufficient labour into the land; and in trying to live on the business the first few years before a business connection was established.

2. *Insufficient experience*, a start being made directly after a college training before gaining further experience in the branch of horticulture to be taken up.

3. ***Breakdown in health***, which has often been an outcome of the first two causes.

Small Holdings of the Gardening Type.—Under this heading have been classed holdings where poultry and bee-keeping are carried on, although gardening may still predominate, especially as regards fruit. The holdings are, as a rule, of a larger acreage than those cultivated solely as gardens, and consist, to some extent, of grass land or grass orchard. Sometimes goats and pigs are added, and perhaps a cow or two, and it becomes more of an agricultural undertaking.

The writer has been much more struck with the possibilities of this type of holding as a suitable occupation for women where capital is limited, than with the purely horticultural type. As the majority show an agricultural bias they will be considered under "Small Holdings," in the second part of the report, which deals with the agricultural side.

Jobbing Gardening.—Information has been collected from 28 women who are, or have been, engaged in jobbing gardening in different parts of the country.

Of these, 3 carried it on in connection with their own nursery gardens, and employed men whom they sent out to do the heavier work. They did not make much profit on the men's work, but considered the advantage in combining jobbing with a nursery lay in the advertisement it brought to the latter.

In another case two women ran a very small nursery together, and employed another woman, and they all three went out jobbing at 5*s*. a day. In and near London those with jobbing businesses employ men and other women, and work themselves, getting their plants from outside nurseries at trade prices. The high price of land would prevent them from having their own nursery unless the business was on a large scale and a large amount of capital was available. Most of the women jobbers in country towns merely work themselves, without employing other labour.

The disadvantages appear to be chiefly the question of remuneration. It is not considered possible to live entirely on the pay; the maximum when starting (in London) will be 7*s*. 6*d*. × 6 = £2 5*s*. a week. This maximum will be discounted by many blank days, especially in winter, when it is too wet to work. It is, therefore, only suitable for a woman who has her home behind her, or a supplementary income. If she is dependent on the business, a woman has also to be very strong, so as to be able to fulfil her

engagements, and not lose days, or disappoint employers owing to ill-health.

The general opinion appeared to be that there was an opening in jobbing, at any rate in the London district. The women were competing with men who only got from 3s. 6*d*. to 4s. 6*d*. a day, but whose standard was often very low, and did not amount to much more than sweeping paths and mowing, whereas the woman jobber always tried to keep the garden bright with flowers. Several women workers advised employing men to do the rougher work, for they did it more quickly and thoroughly, while it paid the woman to devote herself to the floral work, the care of fruit trees, etc.

A few women in the more rural districts had very small gardens, and jobbed, or did landscape gardening as supplementary work.

The rates of pay for a woman working herself were as follows :—

London and District.—7s. 6*d*. to 10s. 6*d*. a day, according to whether the work was regular or occasional or of the skilled kind, such as pruning.

Near London.—5s. to 6s. a day, 7s. 6*d*. for special work.

Country Districts.—3s. 6*d*. to 5s. a day of 8 hours; tea and occasionally lunch might be added.

A summary of the opinions collected suggests that the advantages of jobbing are the following: That one is more independent than a gardener on a private place; it is a less lonely life, one works daily for different employers, and seems to have more intercourse with them. It is a suitable employment for girls living at home, especially if they are not very strong, and need only a supplementary occupation; in this case they need only arrange for as many days a week as they care about, and if they charge by the hour they need not overtax their strength by working long hours, or do inferior work owing to fatigue.

One woman has made a success of doing a sort of consultant jobbing; she advises girls taking up jobbing to do so as a stepping stone to this, and make themselves proficient in special branches such as fruit work, rose culture, and herbaceous plants. People were very often glad of advice in different subjects, and would pay up to 10s. 6*d*. a day for it.

Landscape Gardening.—This is often undertaken locally by the women who have nurseries; but only one case was found of a woman who called herself a landscape gardener. This lady spent much of her time going to distant places to undertake the laying out of new gardens, or the adaptation of old ones, and made a speciality of garden design.

The following figures have been given in connection with the pay received by various gardeners at different times: 10 per cent. on jobs of which the contract price is up to £250, and 5 per cent. after that; 30*s.* a week, board, lodging, and fares; £2 2*s.* a week, and fares.

Gardening Schools.—A certain number of women who have had horticultural training have started gardening schools, and a few have been very successful, both financially and in the good training they impart. Others, however, may be keeping a financially unsound business going on pupils' labour and pupils' fees—with doubtful benefit to the pupils.

The writer is at the moment regarding schools from the standpoint of an opening as a profession for women, and, therefore, feels bound to state that there is a strong feeling against women setting up more schools at the end of a college training.

There are already schools which owe their origin to considerations other than the horticultural education of women. A limited number of these may be useful if they cater definitely for the woman who is not taking up horticulture seriously as a profession, but who desires an occupation on outdoor lines. Such are, for instance, institutions of another kind which have a large garden, and have adopted this method of turning surplus resources to good account.

Small schools with inadequate teaching facilities run a greater risk than the larger ones of turning out women seeking posts as gardeners who have not had sufficient training, and who tend to lower the reputation for efficiency amongst women gardeners generally.

Specialists.—No evidence has been received to show whether many women have attempted specialising in one branch. In the single instance which came under notice, the result was very encouraging. The lady in question had become interested in the Mendelian theory, and started experiments in sweet peas. She began on one acre 12 years ago, and has gradually built up a large seed business on 14 acres of land, with rows of sweet peas totalling over 10 miles in length. At first all the seeds were sold direct to the public, and in course of time a large connection was formed; now, however, they are all disposed of through one firm; this means that the winter months are practically a free time from work. No doubt such successful results would not be obtained by all, but there must be other women capable of following the above example.

(*Continued.*)

CO-OPERATIVE FARM IMPLEMENT SOCIETIES (*continued*).

T. WIBBERLEY, N.D.A., N.D.D.,
Agricultural Expert to the Irish Agricultural Organisation Society.

Agricultural Motors.

REFERENCE has already been made to the increased difficulties of the tillage farmer in consequence of the war. He has in many instances to contend with a diminished supply of both manual and horse labour, and in these circumstances an account of the working and possibilities of the agricultural tractor, the latest addition to the list of implements purchased by Irish co-operative implement societies will be useful.

Since only about 5 per cent. of the farmers in Ireland have more than 100 statute acres of land it is only very rarely that the individual farmer is in a position to buy an agricultural motor for his sole use. Usually co-operative purchase must be resorted to. The demand amongst the co-operative implement societies is for what may be termed an all-round agricultural motor—an implement which can be used not only for tillage, but for harvesting operations, for working threshing machines and grinding mills, for road haulage, and also in many cases for making land drains. Again, since the average agriculturist has not much mechanical skill, the motor must be "fool-proof." The smaller farmers, also, require a motor, which, speaking generally, can work under the same conditions as a team of horses. On the other hand, the larger farmers usually having comparatively large fields (10 to 20 acres) have found it more economical to purchase a larger type of motor.

An agricultural motor which appears to fulfil most nearly the requirements mentioned above is a tractor made in several sizes varying from 10 to 50 h.p.

Societies consisting of small farmers usually purchase the 10-h.p. model, whilst farmers with larger holdings find the 20-h.p. model best suited to their requirements. In view of their greater weight and size the more powerful motors are not suitable for Irish conditions.

The 10-h.p. model weighs 35 cwt. Like the other models of this type it is built on four wheels and mounted on the three-point suspension principle. This latter feature eliminates to a large extent the strain on the main frame when crossing furrows or doing road haulage work. Roads in rural Ireland are not of the best, and it may be pointed out that, whilst these motors have their front wheels spring-mounted, it would

be very desirable to have springs mounted on the hind wheels if much road haulage is undertaken.

This model is also fitted with a special double-furrow plough, by means of which the driver, unaided, can operate the plough in a very efficient manner. The makers do not guarantee this model to plough more than two furrows at a time, and state that it is more economical for the tractor to plough two furrows at a time than three. This, however, is not the writer's experience. The motor has three forward speeds of 2, 3 and 5 miles per hour. When ploughing two furrows the motor will travel on the second or three mile per hour speed, with one man operating both tractor and plough. In practice, however, it has been found an advantage to have an assistant with the motor driver and to attach another plough (an ordinary horse wheel plough will suffice), drive the motor on the low gear and plough three furrows at a time. Working in this manner more ground can be covered, there is less turning at the headlands, the motor travels at a slower pace, and, in consequence, the ploughing is done in a more efficient manner. Furthermore, if during the day's work anything is required for the motor—fuel, oil, water, etc.—the assistant is available for this purpose; meanwhile the driver may proceed with the two-furrow plough, and thus loss of time is avoided. On any except the very lightest of land this model is not capable of ploughing even two furrows against a gradient of say 1 in 7. Where the gradient is severe it has been found more economical for all the ploughing to be done downhill; the motor then travels against the gradient idle, ploughs down the hill with its own two-furrow plough and, in addition, according to the gradient, pulls an ordinary single or double-furrow plough.

Makers of agricultural motors usually recommend gradients to be ploughed at right angles to the incline, but this is hardly good agricultural practice; the farmer will at once recognise the value of ploughing the land in the same direction as the gradient in order to obtain the maximum surface drainage.

In speaking of ploughing three or four furrows with this small tractor, the English farmer should be careful to note that, as a general rule, only the light or easily-worked land in Ireland is under cultivation. Perhaps the statement that for ploughing work this model has a haulage force equal to that of three draught horses, will give a better idea of the motor's capacity. It might also be pointed out that if this motor is capable of ploughing two or three furrows on stubble or loose land it is also capable of doing the same on similar

land when in lea. This is due to the fact that lea land furnishes a better gripping surface for the driving wheels and thus prevents " back-slip."

For motor work on land a good gripping surface, or in other words a dry condition of the soil, is essential if economical and satisfactory work is to be performed. Most makers—especially those who make light motors—claim that by attaching spuds or grips to the wheels, the land can be cultivated with their motors at any time that the soil is fit for horse work. Such, however, is not the writer's experience, for when working on moist soil—and yet not too moist for horse work—even light motors, fitted with a caterpillar track, slip and consequently suffer great loss of haulage power; while with heavy motors, not only does back-slipping and loss of haulage power result, but also puddling of the soil. It should be understood that the motors referred to are assumed to be hauling their normal loads. Back-slipping and puddling when working on moist soils can be avoided by considerably reducing the normal load: but if this is done the work, in comparison with horse labour, is neither economical nor expeditious.

It may be pointed out, however, that since ploughing or soil cultivation with an agricultural motor can be carried out very expeditiously, tilling of the land under moist conditions can largely be avoided.

Cost of Motor Ploughing.—Working with the 10-h.p. motor in the manner indicated above, and ploughing 3 furrows at a time with the assistance of 2 men, 3 statute acres of ploughing per day can be accomplished. The fuel consumption for this amount of work is from 3½ to 4 gal. of paraffin per acre, and about ½ gal. of petrol per day. The cost of lubricating oil for the day's work is about 1*s.* 6*d.* Leaving depreciation out of consideration, the cost of ploughing 3 acres of land, taking the cost of paraffin and petrol as 8*d.* and 1*s.* 3*d.* per gal., respectively, and the man's and assistant's wages (a boy suffices) as 6*s.* per day, may therefore be set down as follows :—

	s.	*d.*
Paraffin, 12 gals. at 8*d.* per gal.	8	0
Petrol, ½ gal. at 1*s.* 3*d.* per gal.	0	7½
Lubricating Oil	1	6
Wages	6	0
Cost of ploughing 3 acres	16	1½
,, ,, 1 acre	5	4½

It is very difficult to say what charge should be made for depreciation. From the experience which the writer has had

Fig. 1.—Agricultural motor hauling 3-furrow *Plough*, cutting 30 in. wide × 8 in. deep on wet clay land.

Fig. 2.—Agricultural motor and special 2-furrow Plough, operated by the driver. It can also be used to haul a 2-furrow independent plough.

with these motors, there seems no reason why, with ordinary care, they should not last ten years. If such be the case the annual depreciation in the case of the light model would be from £18 to £19, whilst an extra £5 may be allowed to cover the cost of annual repairs. With the 20-h.p. model the fuel and lubricating oil and cost of attendance are comparatively less, and whilst the writer has kept no exact account as to the cost of ploughing with this model, he believes that it will be about 1s. per acre less than when the 10-h.p. type is used. It may be added that, on average Irish soil, the heavier type of machine has no difficulty in ploughing four furrows at a time.

Societies are recommended to hire out their tractors for ploughing at the rate of 10*s.* per acre to members and 12*s.* per acre to non-members, the society paying the wages of the driver and bearing the cost of fuel, lubrication, and repairs.

Motor Engine Threshing.—It is intended later to give full details of the different sizes and types of threshing machines used by co-operative implement societies. It may here be mentioned that the type of thresher used in combination with the 10-h.p. motor is one with a drum 3 ft. 3 in. long and 24 in. diameter. The drum is of the steel-pegged beater type, with an adjustable concave and having a speed of 720 revolutions per minute. With this thresher driven by the light motor, an average of 1,500 stones (of 14 lb.) of corn can be threshed per day, the corn also being sorted into " firsts " and " seconds," winnowed and bagged ready for sale. The cost of fuel and lubrication for the threshing of this amount of corn is about 10*s.*, and since a charge is made of ½*d.* per stone of corn threshed, the society paying the wages of 2 men only, it will be understood that threshing is the most profitable work from the society's standpoint. The thresher mentioned above weighs 31 cwt., and since the light model tractor can quite easily haul 2½ tons on the road, the removal of the thresher from farm to farm presents no difficulty.

The 20-h.p. tractor will drive a full-sized threshing machine just as effectively as an ordinary steam threshing engine of 6 nominal horse power. With such a thresher about 2,500 stones of corn can be threshed per day. The fuel consumption for the engine whilst threshing is about 2½ gal. of paraffin per hour, whilst lubricating oil will cost about 2*s.* per day. This model is capable of hauling a load of 5 tons, even on Irish roads, so that the transport of the thresher, which weighs from 3½ to 4 tons, is well within its capacity.

(*Continued.*)

NOTES ON FEEDING STUFFS IN SEPTEMBER.

From the Animal Nutrition Institute, Cambridge University.

THESE monthly notes have appeared in each number of the *Journal* since March.* The meaning of food units and other terms, and the methods of calculation, were explained in the first article.

The large table (p. 576) gives the prices of most of the common feeding stuffs at London, Liverpool, Hull and Bristol; also the nutritive ratio and the number of food units per ton. From these figures the price per food unit is calculated and recorded in the last four columns. In most cases the price per ton is about the same in all four markets, but in the case of some feeding stuffs there is considerable variation. For instance, English linseed cake, decorticated cotton cake and American maize are much dearer in Liverpool than elsewhere. The following list of feeding stuffs (see below), arranged according to price per food unit, is compiled from the average prices at all four markets. It shows that prices have advanced all round, as is usual at this time of year when buying for the winter begins. In many cases the increase in price is considerable; for instance, coconut cake, palm-nut kernel cake, linseed cake, cotton cake, and feeding barley have all advanced 2*d.* or more per food unit, or nearly £1 per ton. Earth-nut cake, or as it is often called, ground-nut cake, has been added to the list, and is, at present prices, the cheapest concentrated food on the market. If

Average Prices per Food Unit.

	s.	*d.*		*s.*	*d.*
Brewers' grains (wet) ..	0	11	Wheat middlings ..	1	9¾
Ground nut cake ..	1	3	Linseed cake, Indian ..	1	10¼
Maize gluten feed ..	1	4	Maize, American ..	1	11¼
Soya bean cake.. ..	1	5½	Linseed cake, English ..	1	11½
Decorticated cotton cake	1	7¼	Maize meal	1	11¾
Coconut cake	1	7¼	Beans, Chinese	2	0
Maize, Argentine ..	1	7¼	Beans, English	2	0
Brewers' grains (dried) ..	1	7¼	Wheat Sharps	2	1
Wheat bran	1	7½	Peas, English dun ..	2	2
,, pollards	1	7¾	Cotton cake, Egyptian ..	2	2½
Maize germ meal ..	1	8¼	,, ,, Bombay ..	2	4¼
Palm-nut kernel cake ..	1	8½	Peas, English maple ..	2	5¼
Malt culms	1	9	Oats, Argentine	2	8¾
Rice meal, Burmese ..	1	9¼	Peas, Calcutta white ..	2	9
,, ,, Egyptian ..	1	9¼	Barley, English feeding	2	9¼
Wheat bran, broad ..	1	9½	Oats, English	3	1¼

* This *Journal*, March, 1915, p. 1111; April, 1915, p. 52; May, 1915, p. 148; June, 1915, p. 248; July, 1915, p. 322; August, 1915, p. 456.

any considerable quantity is available it ought to be of great use to stock feeders during the coming winter. It contains 45 per cent. or rather more of protein (albuminoids), and 7 or 8 per cent. of oil, and is a most valuable feeding stuff for general purposes. A full account of its properties was given in this *Journal* for July, 1915. p. 308, to which readers o these notes who may think of buying ground-nut cake are referred. The writer used it some years ago for fattening bullocks in the winter along with chaff and roots. The bullocks soon got to eat it well, and made satisfactory increases in live weight.

Suggested Rations for September.

Horses.—Horses will be getting back to winter rations. With oats at their present prohibitive price the following rations may be used, variations being made as suggested in former notes to meet special cases of extra large or smaller horses and extra hard work: 4 lb. crushed maize, 2 lb. bran, 2 lb. beans or 1½ lb. ground-nut cake, and 2 lb. dried grains.

If the supply of hay is short, and straw forms the greater part of the "bulky fodder," the ration should be altered thus: 4 lb. crushed maize, 4 lb. bran, 2 lb. beans or 1½ lb. ground-nut cake, and 2 lb. linseed cake.

Instead of using linseed cake in this ration, crushed or ground linseed at the rate of 1 lb. per head per day may be boiled in water until it jellies, and then be used to damp the straw chaff, which, when treated in this way, is an efficient substitute for hay.

Milking Cows.—After the recent spell of cold showery weather the autumn grass will be wet and inclined to cause scouring. In these circumstances it may be wise to alter last month's rations by the addition of 1 lb. per head per day of cotton cake, because of its binding properties. The following rations are suggested: 1 part cotton cake, 1 part crushed maize, 1 part bran, and 1 part coconut cake; or 1 part cotton cake, 1 part maize gluten feed, and 1 part bran.

At present prices cotton cake is an extravagant feeding stuff to buy, and is only recommended as a reliable antidote to the wateriness of autumn grass. Ground-nut cake is said to have binding properties and to be a safe food for milking cows. Although the writer has no personal experience of using it for this purpose, it is so cheap at the present price that he has no hesitation in suggesting the following rations: 2 parts ground-nut cake, and 2 parts maize; or 1 part ground-nut cake, 1 part coconut cake, 1 part maize, and 1 part bran;

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate prices per ton at the end of August.				Approximate prices per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya Bean Cake	1 : 1·1	122·3	9 7 6	8 15 0	9 0 0	8 12 6	1 6½	1 5	1 5¼	1 5
Decorticated Cotton Cake	1 : 1·3	126·3	9 10 0	11 0 0	—	10 0 0	1 6	1 9	—	1 7
Indian Linseed Cake	1 : 1·9	123·1	11 11 3	11 5 0	—	—	1 10½	1 10	—	—
English Linseed Cake	1 : 2·0	120·1	11 12 6	12 5 0	11 7 6	11 17 6	1 11¼	2 0½	1 11	1 11¾
Bombay Cotton Cake	1 : 2·4	65·3	7 10 0	7 15 0	—	7 15 0	2 3½	2 4¼	—	2 4½
Egyptian Cotton Cake	1 : 2·0	71·9	7 12 6	8 0 0	8 0 0	8 2 6	2 1½	2 2¾	2 2¾	2 3
Coconut Cake	1 : 3·8	102·6	8 1 3	8 5 0	—	8 10 0	1 6¾	1 7¼	—	1 7¾
Palm-nut Kernel Cake	1 : 4·0	83·5	7 7 6	6 15 0	7 0 0	7 10 0	1 9¼	1 7¼	1 8	1 9¾
Ground-nut Cake	1 : 0·9	145·2	9 0 0	—	—	—	1 3	—	—	—
English Beans	1 : 2·6	99·5	9 13 8	10 10 0	9 9 5	9 17 11	1 11½	2 1¼	1 11	2 0
Chinese Beans	1 : 2·6	101·2	10 0 8	10 5 4	—	—	2 0	2 0¾	—	—
English Maple Peas	1 : 3·2	97·2	12 4 5	—	11 11 1	—	2 6	—	2 4½	—
English Dun Peas	1 : 3·2	97·2	11 6 8	—	9 15 7	—	2 4	—	2 0	—
Calcutta White Peas	1 : 2·3	97·5	13 11 1	13 3 2	—	—	2 9½	2 8½	—	—
American Maize	1 : 11	93·8	8 5 8	9 19 9	—	—	1 9¼	2 1½	—	—
Argentine Maize	1 : 11	94·2	7 12 10	7 10 3	7 9 4	7 11 8	1 7½	1 7¼	1 7	1 7¼
Maize Meal	1 : 13	86·5	8 10 0	8 10 0	8 15 0	8 5 0	1 11¾	1 11¾	2 0½	1 11
Maize Gluten Feed	1 : 3·3	121·6	8 0 0	—	—	8 7 6	1 3¾	—	—	1 4¾
Maize Germ Meal	1 : 8·4	99·2	8 7 6	8 5 0	8 5 0	8 10 0	1 8¼	1 8	1 8	1 8½
English Feeding Barley	1 : 7·8	83·0	11 9 7	—	11 4 0	11 15 2	2 9	—	2 8¼	2 10
English Oats	1 : 7·9	75·4	12 10 0	11 16 5	11 13 4	10 13 4	3 4	3 1¼	3 1¼	2 10
Argentine Oats	1 : 7·9	75·4	9 18 11	—	10 2 8	10 13 8	2 7¾	—	2 8¼	2 10
Malt Culms	1 : 3·6	69·9	6 0 0	6 15 0	5 10 0	6 0 0	1 8¾	1 11½	1 7	1 8¾
Brewers' Grains (dried)	1 : 3·4	84·5	6 17 6	—	6 10 0	7 0 0	1 7¾	—	1 6½	1 8
Brewers' Grains (wet)	1 : 3·4	21·1	0 15 0	—	1 4 0	—	0 8½	—	1 1½	—
Egyptian Rice Meal	1 : 10·3	78·7	7 5 0	—	6 15 0	—	1 10	—	1 8½	—
Burmese Rice Meal	1 : 10·3	78·7	{ 7 0 0 / 6 15 0 }	7 5 0	6 12 6	7 5 0	{ 1 9¼ / 1 8½ }	1 10	1 8	1 10
Wheat Middlings	1 : 5·3	93·4	8 10 0	—	7 5 0	9 15 0	1 10	—	1 6½	2 1
Wheat Sharps	1 : 5·3	86·3	8 7 6	9 5 0	9 0 0	9 0 0	1 11¼	2 2	2 1	2 1
Wheat Pollards	1 : 5·3	81·9	—	6 15 0	—	—	—	1 7¾	—	—
Wheat Bran	1 : 5·3	77·5	6 5 0	6 10 0	6 0 0	6 10 0	1 7¼	1 8	1 6½	1 8
Wheat Bran (broad)	1 : 4·7	79·9	7 5 0	7 2 6	7 0 0	7 5 0	1 9¾	1 9¼	1 9	1 9¾

The prices quoted for English feeding barley, English oats and English beans on the London market are for last year's crop. *The London prices for new season's crop, early September delivery*, of English feeding barley, oats and peas are about 5s. lower than those quoted. The quotation for soya bean at Liverpool is for meal not cake.

or 1 part ground-nut cake, 1 part maize gluten feed, and 1 part bran.

In using all these mixtures, the ration should vary according to the yield of milk. All cows should get 3 lb. per head per day, *i.e.*, rather more than was recommended last month, as the grass is likely to be of lower nutritive value. Cows giving more than 2 gal. of milk per day should get an extra pound per day for each extra gallon.

Baby Beef.—Calves 8 to 10 months old which are to be brought out fat at 12 to 16 months should be pushed on, and may be given 4 to 6 lb. per head per day of some such mixture as the following: 1 part linseed cake, 1 part ground-nut cake, 1 part maize, and 1 part rice meal.

If plenty of turnips are available a suitable mixture is: 1 part linseed cake, 1 part maize germ meal, and 2 parts coconut cake.

Young stock do not take to ground-nut cake readily, and it is bad practice to check their progress by giving them food they do not like. By taking some trouble to introduce it little by little into their ration ground-nut cake may gradually be substituted for linseed cake in the above mixture, with very considerable economy.

Beef on aftermath.—The following rations are suggested for moderately fresh stores about 20 months old, weighing about 8 cwt. live weight: 1 lb. linseed cake, 1 lb. cotton cake, and 1 lb. coconut cake.

As their weight goes np the coconut cake may be increased up to as much as 4 lb. per head per day. Again it should be noted that at present prices cotton cake is an extravagant food, but necessary to prevent scouring on watery aftermath.

A more economical ration would be: 1 lb. linseed cake, 1 lb. ground-nut cake, and 1 lb. coconut cake. This should be satisfactory if the ground-nut cake possesses the binding properties with which it is credited. As before, the ration should be increased as the animals get heavier until the gronnd-nut cake and the coconut cake amount to 2 lb. of each per head per day. If the animals eat the ground-nut and coconut cakes readily the dearer linseed cake may be dropped. If signs of scouring appear, a little cotton cake should be added to the ration, in spite of its high price per food unit.

Beef in Yards on Roots and Chaff.—The following treatment may be suggested for 2-year-olds of about 8 cwt. live weight to come out fat during the winter or early spring. Along with their ordinary ration of roots and chaff the cheapest concen-

trated food to use at present prices is ground-nut cake. A start should be made with a small allowance of, say, 2 lb. per head per day. As soon as this is eaten readily the allowance may be increased until at the end of about 12 weeks the ration reaches 6 lb. per head per day. For the next month or so a small extra ration of, say, 3 or 4 lb. per head per day of a mixture of linseed cake and bean meal may be given in addition to the ground-nut cake to put a "finish" on the animals. At the present high price of feeding stuffs this is as far as it is profitable to go. A further month with more linseed cake and bean meal will put on a higher-class finish, but the increase in weight will be small and the cost of the extra feeding very great. Reasonably well-finished animals nowadays command such good prices that it is likely to pay best and to be most economical of food to rest satisfied as soon as the rate of increase in live weight gets slow, and, with the feeding suggested above, this will probably be in about 16 weeks.

Sheep.—For *ewes going with the ram* a safe and reasonably economical ration is about ½ lb. per head per day of a mixture of equal quantities of linseed cake and dried grains. The ration should vary with the size of the ewes and the quality of the fold or pasture.

For *Hogs or Tegs* folded on rape, mustard, cabbage or turnips, from ½ to 1 lb. per head per day, according to size, of one of the following mixtures may be fed: 1 part coconut cake, 1 part maize meal or crushed maize, 1 part maize germ meal, and 1 part rice meal; *or* 1 part dried grains, 1 part maize meal or crushed maize, and 1 part bran; *or* 1 part decorticated cotton cake, and 1 part maize meal or crushed maize; *or* 1 part decorticated cotton cake, and 1 part rice meal.

If no hay chaff is available and the sheep are so forward as to refuse straw chaff, ¼ lb. of bran per head per day should be added to the above rations.

The writer has no experience of ground-nut cake for sheep, but the price may tempt farmers to use it, in which case it is suggested that ground-nut cake may be gradually worked into the above rations in place of decorticated cotton cake.

Pigs.—The following mixtures may be suggested as substitutes for barley meal, the price of which is still prohibitive: 4 parts maize meal, 1 part ground-nut cake or palm-nut cake, and 2 parts sharps; *or* 2 parts maize meal, 2 parts rice meal, 1 part coconut cake or palm-nut cake, and 1 part bean meal; *or* 2 parts rice meal, 2 parts maize germ meal, and 1 part coconut cake or palm-nut cake; *or* 2 parts maize meal, 2 parts rice meal, and 1 part ground-nut cake.

Cases have recently been come across of fat hogs breaking their hind legs after being fed for some time exclusively on rice meal. Rice meal and maize meal make excellent pig foods if supplemented with other foods rich in protein and ash constituents, such as those suggested above. Cases also occur of the other extreme, where pigs have been fed exclusively on cheap cake, which is not to be recommended, though for other reasons.

IMPORTS OF GRAIN IN THE CEREAL YEAR 1914-15.

THE effect of the war on our supplies of grain may conveniently be considered at the end of the cereal year (1st September to 31st August), at which date it is possible to ascertain the extent to which imports of grain from our Colonies and from foreign countries have supplemented the home harvest of 1914.

The imports of *wheat* into the United Kingdom amounted to 22,483,587 qr. (of 480 lb.), these being less by 783,588 qr. than the imports of 1913–14 and by 4,016,978 qr. than the imports of 1912–13. Including the produce of the home wheat crop of 1914, and converting the imported flour into an equivalent quantity of wheat, the total quantity of wheat available for consumption in the United Kingdom was 33,817,000 qr. compared with 34,008,000 qr. in 1913–14 and 37,325,000 qr. in 1912–13. In these amounts seed is included, but not stocks carried over. Similar figures for recent years are given in the following table :—

Harvest Year.	Wheat Crop of the United Kingdom.	Imports of Wheat during the Cereal Year, Sept. 1–Aug. 31.	Imports of Wheat Flour in equivalent Weight of Grain.	Total Imported Wheat and Flour in equivalent Weight of Grain.	Total estimated Wheat Grain available for Home Consumption (including seed)
	qr.	qr.	qr.	qr.	qr.
1905–6 ..	7,541,600	22,063,580	4,677,330	26,740,910	34,282,510
1906–7 ..	7,577,300	22,105,180	4,284,490	26,389,670	33,966,970
1907–8 ..	7,066,400	21,362,720	4,339,090	25,701,810	32,768,210
1908–9 ..	6,741,200	21,727,220	3,554,650	25,281,870	32,023,070
1909–10	7,899,600	24,099,060	3,501,520	27,600,580	35,500,180
1910–11	7,074,200	23,516,140	3,263,380	26,779,520	33,853,720
1911–12	8,039,200	24,109,260	3,324,140	27,433,400	35,472,600
1912–13	7,175,300	26,500,565	3,648,883	30,149,450	37,324,750
1913–14	7,087,100	23,267,175	3,654,048	26,921,220	34,008,320
1914–15	7,804,000	22,483,587	3,529,573	26,013,160	33,817,160

Compared with the previous cereal year, therefore, the decrease in the imports was practically counter-balanced by the increase in the home wheat harvest, and the total estimated grain available for home consumption in 1914–15 fell short of that in 1913–14 only by the very small amount of 0·6 per cent.

With regard to the countries from which the supply of wheat was drawn, the receipts from each of the principal sources of imported wheat are given below :—

Country of Export.	Thousands of cwt.			
	1914–15.	*1913–14.*	*1912–13.*	*1911–12.*
India	16,018	11,477	23,152	21,468
Russia	635	9,566	7,379	8,520
Argentina	12,175	6,991	18,617	16,823
United States	40,806	30,496	31,569	16,619
Canada	25,159	24,977	21,249	19,819
Australia	1,297	14,300	9,738	15,170

The year's wheat trade was marked by the large decreases in the imports from Australia and Russia, the other chief countries of supply all sending us increased quantities. This is now the third year in succession in which the United States has been the chief source of our imported wheat supply, which is all the more remarkable in that, for the four years prior to 1911–12, there was a continuous decrease in the imports from that country; the quantity imported from the United States in 1914–15 (40,806,000 cwt.) is larger than in any year since 1901–2 (41,584,000 cwt.). The receipts from Canada in the last five years show a steady increase, those in 1914–15 (25,159,000 cwt.) being again the largest yet recorded from that country.

The price of home-grown wheat rose from an average of 32*s.* 4*d.* in 1913–14 to 49*s.* 9*d.* in 1914–15. During the year there was in general a rise from 36*s.* 5*d.* in September, 1914, to 62*s.* towards the end of May, 1915, somewhat lower prices being returned after that date, and the price at the end of the cereal year being 51*s.* 11*d.* per qr. The average declared value of imported wheat rose from 34*s.* 7½*d.* in 1913–14 to 50*s.* 10*d.* in 1914–15, *i.e.*, a rise of 47 per cent. (as compared with a rise in price of 54 per cent. for home-grown wheat). The average declared value of imported wheat in previous years was 36*s.* 2*d.* per qr. in 1912–13, 35*s.* 11*d.* in 1911–12, 33*s.* 10*d.* in 1910–11, and 37*s.* 5*d.* in 1909–10.

English barley averaged 32*s.* 6*d.* per qr. (a rise of 5*s.* 8*d.* compared with the preceding year), while English oats averaged 28*s.* 8*d.* (a rise of 9*s.* 7*d.*). The value of imported barley was 29*s.* 7*d.* per qr., and of imported oats 29*s.* 5½*d.* per qr., compared with 24*s.* 1½*d.* and 16*s.* 7*d.*, respectively, in the previous year. It is worthy of note that while English oats rose in price by 50 per cent., imported oats rose by as much as 78 per cent.

The following table shows the average prices of British wheat, barley and oats ascertained under the Corn Returns Act in each of the cereal years since 1905–6. The quantities given in the table are the quantities returned as sold, from which the averages are calculated :—

Average price of British wheat, barley, and oats ascertained under the Corn Returns Act in each cereal year since 1905–6.

Harvest years.	Prices per quarter.			Quantities sold at certain markets.		
Sept. 1–Aug. 31.	Wheat.	Barley.	Oats.	Wheat.	Barley.	Oats.
	s. *d.*	*s.* *d.*	*s.* *d.*	Quarters.	Quarters.	Quarters.
1905–06	28 9	24 2	18 5	2,940,263	3,202,613	940,015
1906–07	28 1	24 5	18 4	2,830,991	3,376,615	1,219,419
1907–08	32 9	25 8	18 2	2,944,256	3,564,908	1,530,848
1908–09	36 6	26 11	18 10	2,962,825	2,972,889	1,054,318
1909–10	32 6	23 10	17 8	3,144,873	2,988,483	795,824
1910–11	30 11	24 9	17 8	2,799,763	2,992,128	831,898
1911–12	34 10	31 2	21 6	2,944,995	2,645,477	719,495
1912–13	32 0	27 10	19 7	2,324,474	2,489,932	630,276
1913–14	32 4	26 10	19 1	2,746,702	3,438,159	850,308
1914–15	49 9	32 6	28 8	3,164,978	3,132,773	1,244,465

The aggregate imports of the principal cereals in each of the past ten years are given below :—

Harvest Year.	Millions of cwt.				
	Wheat.	Wheat Meal and Flour.	Barley.	Oats.	Maize.
1905–6 ..	94·6	14·4	20·3	16·0	47·1
1906–7 ..	94·7	13·2	19·5	10·9	51·7
1907–8 ..	91·6	13·4	17·5	13·2	39·5
1908–9 ..	93·1	11·0	22·0	15·5	39·0
1909–10 ..	103·3	10·8	19·9	19·6	34·6
1910–11 ..	100·8	10·1	20·1	16·6	46·0
1911–12 ..	103·3	10·3	21·9	18·4	32·1
1912–13 ..	113·6	11·3	22·4	20·0	49·5
1913–14 ..	99·7	11·3	21·2	15·4	40·2
1914–15 ..	96·4	10·9	12·7	15·4	48·0

Thus, although imports of wheat, wheat meal and flour, and barley declined, there was no fall in the imports of oats, and we received nearly eight million cwt. more maize in 1914–15 than in 1913–14. The increased supplies of maize were due to an increase of 12 million cwt. on the imports from Argentina in 1914-15 as compared with those of 1913-14.

WINTER OATS.

WHILE endeavouring to increase the area under wheat, farmers should arrange, if possible, not to reduce the area under oats, for, to a nation at war, this grain may be just as useful as wheat, and the straw is of special value as fodder for stock. In many districts, particularly in the south of England, repeated attacks by frit-fly (sometimes called "bottling") have rendered spring oats a precarious crop. Winter-sown oats, however, are less liable to attack by this pest, and might, therefore, receive increased attention at the present time. They are also better adapted than spring oats for land badly infested with charlock.

Varieties of Winter Oats.—Two varieties are commonly grown, namely, Winter Grey or Dun Oat, and Winter Black Oat. In deciding which to grow, farmers should be guided largely by local experience, for while both may grow equally well in any particular district, there is sometimes a keener local demand by merchants for one than for the other. The black variety possesses somewhat stronger straw than the grey, and might generally be given the preference on land subject to "lodging." It is more liable to shed its seed than the grey variety, and should be cut before it is dead ripe. In neither case is the straw so palatable as that of the finer spring varieties, but when chaffed and mixed with cake and meal it is readily eaten by stock.

Soil and Cultivation.—Winter Oats are suited to a wide range of soils. They can be grown successfully on soils too light or too poor for wheat, and they prevent such soils from "washing" in a wet winter. Further, they can be taken as a second corn crop, provided the land is clean. They are not so hardy as winter wheat or winter barley, and consequently must be sown earlier, preferably in September, so that the plants may become well established before cold weather sets in. The ground should be left somewhat rough as a protection against cold winds; and with this object in view it is customary in some districts not to harrow after drilling.

Unless the land is thoroughly clean, weeds, favoured by a longer growing period than usual, may seriously reduce the crop.

About 3 to 4 bush. per acre should be sown; the earlier the sowing and the cleaner the land the less the quantity of seed necessary.

Winter oats often contain seeds of a Brome Grass (*Bromus secalinus*), a troublesome weed on light land; purchasers should see that seed oats have been carefully cleaned.

Winter oats are best suited to the warmer southern counties, and are generally ready for cutting from ten days to a fortnight before other corn crops. This enables the land to be prepared sooner for the following crop, a point of some importance when farming is conducted at high pressure. On the other hand, the earlier ripening is a disadvantage near towns where birds are numerous.

ECONOMY IN FOOD.

APPEAL TO COUNTRY PEOPLE.

Produce Food for Yourselves!

Everyone who lives in the country or has a garden can produce *something* to eat—the more the better: vegetables, fruit, poultry, eggs, rabbits, milk, cheese. Plant at once what you can, and prepare in all possible ways for next year's cropping!

Every Plant in your Garden may Save you Money!

Produce all you can; buy as little as possible! Cultivate thoroughly! Destroy insect pests and weeds! Prepare manure!

Preserve and Store your Crops with the Greatest Care!

The finest harvesting may be rendered useless by bad storing. Protect from the weather! Destroy vermin! Store your own vegetables! Bottle your fruit or make jam or pulp of it! Preserve your eggs when abundant! Cure your own bacon!

Eat Little Meat!

Replace meat by milk, cheese, peas, beans and lentils, which are as rich in flesh-formers as meat, and much cheaper. Use more vegetables! Eat more fruit!

Bake your own Bread: It will be Cheaper and Better!

Use whole-meal flour from home-grown wheat, barley and oats. Good, wholesome bread can be made from:—

(1) Household flour, or wholemeal flour.
(2) $\frac{1}{2}$ Household flour and $\frac{1}{2}$ barley meal.
(3) $\frac{7}{8}$ Whole-meal flour and $\frac{1}{8}$ fine oatmeal.
(4) $\frac{4}{5}$ Whole-meal flour and $\frac{1}{5}$ maize meal.

(5) ¾ Household flour and ¼ boiled potatoes.
(6) Oatmeal.
(7) Barley meal.

Cook Vegetables by Steaming!

Boiling in water reduces their food value! Cook potatoes in their skins! *Use the Hay-box Cooker* (see notice below): it will save coal.

Use Less Coal!

Burn wood, peat, etc., whenever possible!

Save Fodder!

Use acorns, chestnuts and beech-mast for stock; bracken for litter; all suitable straw for fodder; fodder crops for pigs! Keep pigs, poultry or rabbits to eat up house refuse, damaged vegetables, light corn!

Waste Nothing!

Buy nothing from abroad that can be produced at home!

For suggestions as to these things read the Board's leaflets. See note below.

READ THIS: IT CONCERNS YOU.

The following short list of pamphlets and leaflets should be read by all who live in the country or have a garden. Read them and follow the advice given!

Economy in Food (Circular 917): Obtainable on application to the Board of Education, Whitehall, London, S.W. Price 1*d.* post free.

How to Save and Why: Obtainable free on application to The Parliamentary War Savings Committee, 12, Downing Street, London, S.W.

Saving the Food of the Nation: Obtainable free on application to the National Food Fund (Educational Campaign), 1A, Dover Street, Piccadilly, London, W.

Hints on Hay-box Cookery: Obtainable free on application to the National Food Fund (Educational Campaign), 1A, Dover Street, Piccadilly, London, W.

Various Leaflets: About 320 leaflets to help do what is suggested above have been issued by the Board of Agriculture and Fisheries.

Any of the Board's leaflets can be obtained gratis and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. Send an unstamped postcard for those you would like and a list of all the Board's publications.

Home Production of Food.

THE President of the Board of Agriculture and Fisheries appointed on 17th June last a Departmental Committee "to consider and report what steps should be taken, by legislation or otherwise, for the sole purpose of maintaining and, if possible, increasing the present production of food in England and Wales, on the assumption that the war may be prolonged beyond the harvest of 1916." The appointment of this Committee was followed by that of committees for Scotland and Ireland with the same terms of reference. The Interim Report of the Committee for England and Wales, of which Viscount Milner is the Chairman, dated the 17th July, has now been published, as well as the Reports of the Scottish and Irish Committees.

The President of the Board of Agriculture and Fisheries in the speech printed on p. 489 announced the Government's decision respecting the English Committee's recommendations.

Report of the Committee for England and Wales.

It did not appear to the Committee to be within the terms of their reference to enquire, nor did they as a matter of fact enquire, into the nature and extent of the danger threatening our imported food supplies. But they state that if in the opinion of the Government, which is alone competent to judge of this question, an emergency is likely to exist after the harvest of next year which calls for the adoption of exceptional measures at the present time, there are certain steps, only effective if taken immediately, to which the Committee felt bound to direct attention.

Guaranteed Minimum Price for Wheat.—The Committee's first recommendation is that a minimum price of 45*s*. a qr. should be guaranteed for all marketable home-grown wheat for a period of four years. It is recommended that any payment to the farmer under the suggested guarantee should be regulated by the difference between 45*s*. and the "Gazette" average price of wheat for the year in which the wheat is harvested, the farmer being left free to dispose of his produce in the open market.

The arguments on which the Committee base the above recommendation are as follows :—

The only method of effecting a substantial increase in the *gross* production of food in England and Wales for the harvest of 1916 and later consists in restoring to arable cultivation some of the poorer grass land that has been laid down since the 'seventies. In this way a large increase in the area under wheat may be obtained upon the existing arable land, while the newly broken-up grass may be devoted to the later-sown crops displaced by wheat. An increase in the area under arable cultivation will, with proper farming, add to the production of wheat and other crops for human consumption, without diminishing the capacity of the country to maintain its existing live stock and its output of meat and milk. Such increase in the arable area must necessitate a greater or more effective employment of labour, but the Committee

believe that over the larger part of the country no such serious shortage of agricultural labour exists as would render their proposals impracticable, although they consider that something may be done to assist the farmer in carrying out the work that he is desired to undertake by an organisation of the supplies of labour-saving machinery and of manure.

To obtain any substantial increase in the production of wheat, oats and potatoes in England and Wales, it will be necessary for farmers to sacrifice the comparative certainty of their present profits, to change some of their methods, to alter their rotations, and to increase their area of arable cultivation in the face of a shortage of labour. In addition they will have to run the risk, not only of uncertain seasons, but also of a fall in the price of wheat at the conclusion of the war. The Committee believe that many farmers would be disposed to make efforts to increase the production of wheat, if appealed to in the national interest. But in order to ensure a general movement in that direction they consider the guarantee which they recommend to be essential.

The Committee estimate that the giving of this guarantee would probably result in the area cropped with wheat, which is now just under *two million acres, being increased by at least another million acres* next year, and that, therefore, from four to five million qr. more wheat would be grown at home—or fully six weeks' additional supply for the whole of the United Kingdom.

The Committee considered the financial aspects of the above recommendation and suggested certain safeguards, but, in view of the fact that the Government have decided not to adopt the recommendation regarding a guaranteed minimum price for wheat, these safeguards need not be reviewed here in detail.

The Committee further recommend that the Government should, without delay, create a local organisation which, in every district, will give farmers a clear lead as to the crops which are considered desirable; the object would be to secure an increase in food production by means of a well-organised effort in every county, careful regard being had to the natural capacity of different parts of the country.

The remainder of the Report deals with restrictive covenants, rent and wages. As it is clearly a national duty to see that all land is kept up to the greatest possible pitch of productivity, where the consent of the landowner to the breaking up of grass land is necessary, the Committee are of opinion that such consent ought not to be withheld; rent should not be increased by reason of the guarantee; and landowners should make sure that their tenants, by good farming, shall put themselves in a position to take advantage of any Government scheme which may be instituted. The Committee are also of opinion that the guarantee would have the effect of bringing about a rise in the rate of agricultural wages, *and that if this is not realised by the operation of natural causes* it would be desirable to take further measures to ensure it, should the proposed guarantee be given.

Report of the Committee for Scotland.

The Scottish Committee, of which the Rt. Hon. Eugene Wason, M.P., was Chairman, considered the means whereby the food supplies of the country may be maintained or increased under three heads:—

A. Increased production.
B. Avoidance of waste.
C. Using sources of supply not at present available.

The following is a summary of the Committee's principal recommendations :—

A.—*Increase of Production.*—Basic slag should be much more generally used for the improvement of grass land and artificial manures should be more generally used in growing crops, especially grain crops. The export of artificial manures should be allowed only under special licence. Where practicable there should be an extension of land under wheat and oats. The advisability of change of seed and of the use of new varieties of oats and other seeds should in all cases be carefully considered at this time. A representation should be made to the railway companies that, following the precedent they have made by carrying breeding horses at reduced rates, they should charge a modified rate for the carriage of grain and potatoes certified to be used for seed.

Wherever possible a greater number of calves should be reared. The keeping of pigs should be encouraged, and to encourage this there should be, so far as is consistent with a due regard for the public health, a relaxation of the by-laws relating to pig-sties, especially in rural districts. The keeping of poultry and the increase of egg production should be encouraged. The prohibition of the export of all feeding stuffs should be continued.

The Board of Agriculture for Scotland should promote and assist demonstrations of the use of motor power in ploughing and other agricultural operations. It should be represented to the military authorities and recruiting agencies that any attempt to increase or even maintain the food production of the country would be made impossible by a further withdrawal from agricultural labour of experienced workers. So far as educational interests allow, School Boards should consider agricultural needs in fixing the time of the school holidays, and should also have regard to special agricultural emergencies in dealing with applications for exemption from school attendance.

Allotments should be provided in the neighbourhood of towns and villages.

Co-operative organisation for the purchase of farming requirements and the sale of produce should be encouraged.

B.—*Avoidance of Waste.*—All liquid manure should be carefully conserved for application to the land. Straw should be saved for fodder as much as possible, and not used unnecessarily for litter. The Prevention of the Slaughter of Animals Order (1915) should on its expiry be renewed so far as it deals with in-calf cows, and calves suitable for rearing as beef-producing animals.

All landowners and shooting tenants should be urged in the interests of the national food supply either to kill as many rabbits as possible or to net woodlands and plantations, or as an emergency measure to allow agricultural tenants the unrestricted privilege of killing rabbits, including (*a*) the right of entry into woods, (*b*) the employment of such increased numbers of men as may be necessary for the work, and (*c*) permission to kill rabbits on moors without reference to any time limit.

Assistance, by defraying a proportion of the cost, should be given by the Board of Agriculture for Scotland to duly constituted bodies who submit to the Board satisfactory schemes for dealing with plagues of rats, sparrows, rooks, or pigeons.

An appeal should be made to all owners of deer forest and grouse moors to allow these to be used—so far as practicable—for grazing cattle or sheep on terms to be mutually arranged. All artificial rearing

of game should be discouraged. The fullest possible use for grazing purposes should be made of golf courses and policies.

General.—A Committee should be set up in the area of each District Committee of each County Council, called the District Agricultural Committee, with the special duty of stimulating production by all possible means. The District Agricultural Committees should co-operate with any agencies which might be able to secure new sources of labour suitable for farm work.

The Governors of the three Agricultural Colleges should be requested to instruct the members of their staffs to co-operate with the District Agricultural Committees, and that, as far as it is possible the members of the College Staff should be relieved of their preseut duties in order that they may promote the object for which the District Agricultural Committees have been set up.

In order to make more effective the proceedings of the County Agricultural Committees, it should be made the duty of an official to be appointed by the Board of Agriculture for Scotland to give such help to these Committees as they may require, to attend their meetings so far as practicable, and to obtain for them such information as they may from time to time desire in the discharge of their duties, and to suggest to them matters for their consideration.

Separate recommendations are made by Mr. Harry Hope as to the constitution and duties of the District Committees. Mr. J. F. Duncan, Mr. Hannah and Professor Somerville make the following recommendations:—

(1) That in the case of all land under rye-grass and other rotation grasses and clover, except such as has been sown with grass and clover in the springs of 1914 or 1915, farmers shall be required to plough up and put under a crop, other than grass or clover, twice as much as they similarly dealt with in 1914-15, provided that such larger area is in existence on their respective holdings.

(2) Farmers desiring exemption from this obligation may appeal to a local committee, acting in conjunction with the Board of Agriculture for Scotland, whose decision shall be conclusive.

Report of the Committee for Ireland.

The Report, which is dated the 14th August, is signed by all the members of the Committee, of which the Rt. Hon. T. W. Russell, M.P., the Vice-President of the Department of Agriculture and Technical Instruction for Ireland, was Chairman, with the exception of Sir Horace Plunkett, who submits a Minority Report.

Majority Report.—The Committee state that, assuming that the Government takes the responsibility of deciding whether exceptional steps should be taken in order to increase the growth of certain crops, then the measure calculated to effect this object in Ireland is the guaranteeing by the Government of a minimum price for wheat and oats. The Committee further agree that the minimum price should apply only to the specific crops named. In regard to the amount of the minimum price, the Committee recommend that the figure should be most carefully estimated "with a view to its being no more than enough to give the farmer a feeling of security in growing the required crop, having regard to the normal conditions of business." As to the length of time during which the guaranteed minimum price should operate, the Committee hold that it should be for one year only. A proposal

going beyond this limit would, it is stated, be regarded as exceeding the requirements of a war measure, and as contemplating a policy upon the expediency of which opinions are sharply at variance.

The Committee are agreed as to the need of a system by which loans should be made to small holders to obtain implements and machinery, and suggest that the County Committees of Agriculture might be asked to take charge of such a scheme in their several districts.

The Committee are unanimous in recommending the prohibition of the export from the United Kingdom of artificial manures and of the constituents used in their manufacture. This prohibition, the Committee considers, is specially necessary in the case of basic slag and sulphate of ammonia.

The Report concludes with an appeal to landholders and labourers to put forth their best energies to promote the vital interests of themselves and their fellow countrymen.

Sir Horace Plunkett's Minority Report.—Sir Horace Plunkett, in his separate Report, explains that the intention contained in the terms of reference is: the working farmers have to be moved to produce more food, and the only question is: How? He then examines the three principles of action (1) Compulsion, (2) Inducement, and (3) Persuasion. Sir Horace agrees with the majority in not recommending compulsion, and is in general agreement with them in regard to their proposal that inducements in the form of insurance against loss should be offered if the Government press upon the farmer an extraordinary departure from his usual method of cultivation. "It is when the majority come to the vastly more important question—what measures might lead to a natural, voluntary and continuing increase in the production of food—" that Sir Horace is completely at variance with them. He gives fuller consideration than is given in the Majority Report to the problem of increasing tillage, the labour question and co-operation. His recommendations on these points are summarised as follows:—

Continuous cropping recommended upon small holdings.

Labour to be organised and mobilised through the agency of Labour Exchanges. No legislative action for raising wages until it is proved that labour does not get its full share of any increase in the revenue of the farmer. Temporary employment of refugees, prisoners of war, etc., to be considered.

Co-operative organisation to be encouraged; and, more especially, to be utilised in enabling small holders to acquire and use suitable implements and machinery.

A small joint committee, consisting of representatives of the Department and the Irish Agricultural Organisation Society, with an impartial chairman, to co-ordinate State assistance with organised voluntary effort in food production, and to move the Government to take certain measures in regard to labour, the supply of agricultural implements and manures, and the provision of funds needed for the combined campaign of better farming and better business.

OFFICIAL NOTICES AND CIRCULARS.

Description of Eggs as Fresh and New Laid.

THE President of the Board of Agriculture and Fisheries has under consideration the steps which can be taken, in the interests of the home producers and of sellers of genuine new laid and fresh eggs, to deal more effectively with the application of the descriptions "new laid," and "fresh" to eggs which, in view of their age or condition, should not be described by these terms, and he has directed an enquiry to be made into the meaning of the terms "new laid" and "fresh" as applied to eggs. The principal question involved is the number of days from the date of laying up to which an egg may properly be described by these terms.

Committee on the Supply of Horses for Military Purposes.

LORD SELBORNE, President of the Board of Agriculture and Fisheries, after consultation with the Chairman of the Advisory Council on Light Horse Breeding, has appointed a Committee to consider and advise the Board what steps should be taken to secure the production and maintenance in England and Wales of a supply of horses suitable and sufficient for military purposes, especially on mobilisation.

The Committee consists of the following members :—

The Lord Middleton (*Chairman*).
The Right Hon. Henry Chaplin, M.P.
The Right Hon. Sir Ailwyn Fellowes, K.C.V.O.
The Hon. Alexander Parker.
Major Sir Merrik Burrell, Bart.
Sir Gilbert Greenall, Bart., C.V.O., and
Captain M. S. Adye.

Mr. E. B. Wilson, of the Board of Agriculture and Fisheries, has been appointed Secretary of the Committee.

Deputation on the Importation of Canadian Cattle.

LORD SELBORNE, the President of the Board of Agriculture and Fisheries, received a deputation on the 10th August from the Free Importation of Canadian Cattle Association and other bodies, to urge upon him the desirability of allowing store cattle from Canada to be landed for fattening on farms in this country. The deputation was introduced by Mr. Edward Watson, Chairman of the Association, and the speakers were Mr. Albert Wadman, farmer, of Sussex, Alderman Stevenson, of Liverpool, Mr. Harry Barnett, of the Jewish Masters' Protection Association, and Mr. H. T. May, Secretary of the Parliamentary Committee of the Co-operative Congress.

In replying, Lord Selborne acknowledged the importance of the deputation, and of the opinions which they expressed, but pointed out that at the beginning of the second year of war we found ourselves with a record head of cattle in the country, which was free from any malignant cattle disease. This was in itself a great justification of the policy of his predecessors of both political parties. The reason why the price of meat had risen was because of the shortage of our over-seas supplies of meat. This was largely a question of tonnage, which applied as much to live cattle as to dead meat. At the present

moment what the people of the country most required was not unfinished store cattle, but meat which they could eat, and he was doing all that he could to revive the trade in cattle to be landed for slaughter. He did not share their opinions, and could not accede to their request, but, as a matter of fact, his answer would have to be the same if he agreed with them, because to meet their views, a Bill amending the existing law would be required, which, under the bargain binding on all parties in the House of Commons at the present time, could not possibly be passed because of its controversial character.

Maintenance of Live Stock Order of 1915.

THE Board have issued the following circular letter, dated 21st August, 1915, to the County Councils, Borough Councils (including Metropolitan Borough Councils), and District Councils in England and Wales :—

Sir,—I am directed by the President of the Board of Agriculture and Fisheries to enclose, for the information of your Council, a copy of the Maintenance of Live Stock Order of 1915 which as from the 23rd inst. supersedes the Slaughter of Animals Order of 1915, together with a copy of a memorandum approved by Lord Selborne setting forth the considerations which have led to the framing of the Order.

Prohibition of Slaughter.

The new Order prohibits, with certain exceptions, the slaughter of—

(1) Animals which are visibly or obviously in calf or in pig ;

(2) after the 30th September next all calves in which the first permanent molar or grinder tooth is not cut and visible, which for practical purposes means calves six months' old ; and

(3) until the 30th September next, calves under the age of eight weeks.

Exceptions from Restrictions.

The Order allows by way of exception—

(1) Slaughter of an animal if necessary or desirable on account of accidental injury to the animal or its illness ;

(2) slaughter of an animal if desirable for an exceptional reason or purpose, and if the slaughter is licensed by the Board ;

(3) slaughter of a calf of a cow of Channel Island, Ayrshire, Kerry, or Dexter breed ; and

(4) slaughter of a calf which has been offered for sale by auction at any market or sale yard in England, Wales, or Scotland without reserve or subject to a reserve price of 30*s*. or less, and for which no bid exceeding 30*s*. has been made on such occasion ; but this provision will have effect only—

(*a*) If the calf so offered for sale is before movement from the market or sale yard marked with a broad arrow by, or under the direction of, the auctioneer in the manner prescribed by the Order ;* and

(*b*) if such mark is on the calf at the time of slaughter.

These exceptions should afford a sufficient means of enabling farmers to dispose of calves which are worthless for rearing purposes.

---

* The prescribed mark for the purposes of the Order is a broad arrow branded, in hot pitch or a mixture of hot pitch and tar, on the back of the calf midway between the hips, the shaft and two barbs of the arrow to be a quarter of an inch in width, and the length of the shaft and of the barbs (outside measurement) to be two and a half inches.

Local Authorities authorised to enforce the Order.

By Article 4 of the Order authority to execute and enforce it is given to county councils and their executive committees for the purposes of the Diseases of Animals Acts, and to borough councils (including metropolitan borough councils) and district councils; and provision is made for defraying any expenses so incurred.

Lord Selborne thinks that it should be possible for these authorities by means of their existing officers to secure a general observance of the restrictions on slaughter which the Order imposes in the interests of the general community, and he trusts that your council will take such steps as are practicable to secure this result.

I am, &c., SYDNEY OLIVIER.

MEMORANDUM.

The Maintenance of Live Stock Order of 1915 has been made by the Board of Agriculture and Fisheries and as from the 23rd August, 1915, supersedes the existing Order dealing with this subject, viz., the Slaughter of Animals Order of 1915.

The main criticisms of the existing Order have been—

(1) That no adequate provision was made for exempting from the restriction of slaughter, calves which were worthless for rearing purposes; and

(2) that the necessity of feeding for twelve weeks calves intended for veal, involved an expenditure in excess of any benefit derived from the growth of the calf after normal age at which calves are at their prime for veal.

Lord Selborne recognises that calves which are unfit to rear—that is, on which no farmer can make a profit by keeping them for store cattle or for breeding—have become unsaleable in consequence of the existing Order. These calves are of two classes: (1) those which, although bred from a good cow and a good bull, have some defect or are prematurely born; (2) those got by a bull so inferior that the calf is practically worth nothing, and apparently there are many of this kind, especially those coming from cows used in town dairies. He regards it as discreditable to British agriculture that many owners of cows should apparently take no trouble at all as to the class of bull which they use, and he would be sorry if in any way the Board seemed to encourage or condone such a practice. At the same time these calves are in existence, and will come into existence for some months to come, and he is prepared to make a concession to enable farmers to sell them so far as is possible consistently with the provisions of the Order of the Board against the slaughter of calves, but he wishes it to be distinctly understood that he holds himself free to withdraw this concession on or after the 1st July, 1916. Full notice will thus have been given to all farmers or owners of cows and opportunity given to seek better bulls for use with their cows.

Lord Selborne has given much consideration to the method of enabling calves of these classes to be distinguished from other calves. It was suggested to him that in each district an officer should be appointed who should be authorised to inspect the calves and to brand those which in his judgment were not suitable for rearing. But this proposal really was not a practicable one, as it would mean the appointment of a great number of new officials and the expenditure of a large sum of money, which could not be contemplated at such a time as this. And, again, every such officer appointed would have to act on his own individual judgment and there would be no regularity of practice or fixed standard of quality, which must result in more discontent

The procedure which he has determined to adopt and which is embodied in the new Order is to allow the slaughter of a calf which has been offered for sale by auction at any market or sale yard in England, Wales, or Scotland, without reserve or subject to a reserve price of 30*s*. or less, and for which no bid exceeding 30*s*. has been made on such occasion ; but this provision will have effect only—

(*a*) if the calf so offered for sale is, before movement from the market or sale yard, marked with a broad arrow, by or under the direction of, the auctioneer in the manner prescribed by the Order ; and

(*b*) if such mark is on the calf at the time of slaughter.

Under the present circumstances if a calf fetches more than 30*s*. presumably it is worth rearing ; if it fetches 30*s*. or less than 30*s*. it may be treated as not worth rearing ; and, therefore, it would be marked by the auctioneer or his assistant, and would be available for slaughter. There will be no compulsion on the purchaser to slaughter the calf, but, on the other hand, he will be free to do so. This price test does not profess to be anything but a very rough and ready method of meeting the case, but it has the advantage of simplicity and economy, and therefore Lord Selborne has adopted it and intends to give it a fair trial. Under this plan, if the owner of a calf which is worthless to rear wishes to sell it for slaughter, he must send it to a market at which there is an auction, or, if he cannot conveniently so send it himself, he must dispose of it to a dealer who can take it there. By this means the grievance that such a calf cannot be sold for slaughter but must be kept and fed, although worthless to rear, will disappear.

Lord Selborne has had the advantage of a consultation with gentlemen representing the profession of auctioneers, and they have assured him that he may feel confident that the auctioneers can work this plan, and will give the Board every assistance in doing so. He is glad to take this opportunity of expressing his appreciation of their obliging attitude.

In respect of calves which are suitable for rearing he desires to express the hope that dairy farmers will endeavour not to send them to market until they are at least a fortnight old, an age at which many of them would be strong enough to travel comparatively long distances.

The effect of the existing Order has been to prevent any abnormal slaughter of calves, but Lord Selborne, after careful consideration, and after consultation with the Agricultural Consultative Committee appointed by his predecessor, has come to the conclusion that it is practicable and desirable in the public interest that the stock in the country should be increased by the total prohibition for a period of the slaughter of all calves suitable for rearing as stock. The new Order, therefore, provides that after the 30th September next, until the Board shall by Order otherwise provide, the prohibition of slaughter shall be extended, subject to the exemption of worthless calves and of calves of cows of Channel Island, Ayrshire, Kerry, and Dexter breeds, to all calves in which the first permanent molar or grinder tooth is not cut or visible, which, for practical purposes, may be taken to mean calves under six months old.

Until the 30th September the restriction on slaughter of young calves will continue in force, but to meet the criticism above referred to the age has been reduced from twelve weeks to eight.

The effect of the Order will be closely watched with a view to its revocation whenever it has resulted in the desired increase of the stock of the country or the feeding facilities render the maintenance of the restrictions undesirable.

Laying Competitions of the Harper Adams College and the Utility Poultry Club.

A TWO years' poultry laying competition will be held at the Harper Adams Agricultural College, Newport, Salop, commencing on 1st October next.

The object of this competition will be to ascertain the profitable duration of a hen's laying, and how far the constitution of a bird is affected by the strain of a heavy first year's laying. It will also be of interest to note during the test whether the size of egg increases during a second year, and whether increase in broodiness lowers egg-production sufficiently to make the birds unprofitable as well as the cost of feeding for two seasons compared with the value of eggs produced.

The competition will comprise an open section of 40 pens of six pure-bred birds each, to be divided into breed sections as follows :—(1) Leghorns, (2) Wyandottes, (3) Rocks, Orpingtons and Rhode Island Reds, (4) Sussex and Faverolles, (5) any other non-setting breed.

A special feature of this competition will be a section, comprising 10 pens, for farmers and small-holders.

Concurrently with the above two-years' competition, a 12 months' competition, comprising 40 pens in an open-breed section, and 10 pens in the farmers' and small-holders' section (on exactly the same conditions as for the two years' test) will be held. This competition will also commence on 1st October next. All enquiries should be addressed to the Principal of the College.

Swine Fever—Treatment by Serum Injection.

THE Board of Agriculture and Fisheries propose to adopt, on the occurrence of an outbreak of Swine Fever, a system of treating all the pigs on the infected premises, if the owner consents, by injection of serum.

Serum is the yellow fluid separated from the blood of pigs which have been rendered highly resistant to Swine Fever.

Its injection is harmless.

It will not cure Swine Fever in pigs already infected with the disease.

It will protect pigs not infected for ten days from any damaging attack of Swine Fever.

If pigs which have been treated with the serum are mixed with pigs suffering from the disease, they will probably catch Swine Fever in a mild form ; and, if they do so before the effects of the serum have worn off, they will remain permanently immune from, or protected against, Swine Fever.

If they are not so mixed, and do not catch the fever in its mild form, they will not remain immune after the ten days, and if infected afterwards will be liable to die of Swine Fever.

Serum will not be injected into pigs without the owner's consent, and the owner of any premises on which Swine Fever is found will be asked whether he will have the animals so treated or not.

It will be to his advantage to do so, because even if they are only protected for ten days, it will be possible for the pigs to be finished for slaughter, or for arrangements to be made for shifting them to a part of the owner's premises which is not infected.

If serum is used, it will be possible to allow owners to restock their premises earlier than under the present regulations of the Board where an outbreak of Swine Fever has occurred.

The Veterinary Inspector, then, at his first visit to premises on which an outbreak of Swine Fever has been reported, will, if he finds

the disease present, offer the owner the choice of having his pigs dealt with either under the ordinary regulations for the time being in force, *or* by serum treatment.

If the owner chooses serum treatment, the Inspector will further give him the choice either of having all ailing pigs slaughtered, with compensation, *or* of leaving the ailing pigs alive, so as to infect the other pigs, after they have been treated with serum, with the mild type of Swine Fever which they can catch whilst the serum is active, and which, if caught, will leave them permanently safe afterwards from disease.

In order to be sure of producing this result, it will be best to leave all the ailing pigs alive, and it will be necessary for arrangements to be made, which the Veterinary Inspector will recommend, for so mixing all the pigs in the yard or in their pens, or allowing them to feed from common troughs, as to ensure as far as possible that all the healthy pigs shall catch the infection, which, if the serum has been given before they catch it, will do them little or no harm.

At the same time it must be understood that some pigs, apparently healthy at the time when the serum is given them, may really be already infected with Swine Fever, and in these cases the serum may not protect them from a severe and even fatal attack of the fever.

Pigs that have had Swine Fever in a severe form may survive, but generally remain unthrifty, and unlikely to repay the cost of feeding. *They are also likely to suffer from other troubles, such as pneumonia,* and thus cause further loss. If any pigs become wasters after the first ten days of the treatment the owner will be wise to slaughter them.

In order to obtain the best results from serum treatment, notification of suspected outbreaks of Swine Fever should be made at the earliest possible date by owners of pigs. Any delay not only renders the owner liable to prosecution, but also tends to increase his loss owing to more pigs becoming affected before serum treatment can be applied.

Acreage of Hops.

THE following is a preliminary statement compiled from the returns collected on the 4th June, 1915, showing the acreage under hops in each county of England in which hops were grown, with a comparative statement for the years 1914 and 1913.

COUNTIES, &c.		1915.	1914.	1913.
		Acres.	*Acres.*	*Acres.*
KENT	East	**5,727**	6,174	6,103
	Mid	**7,238**	7,604	7,481
	Weald	**8,370**	8,848	8,360
	Total, Kent	**21,335**	22,626	21,944
HANTS		**1,514**	1,580	1,556
HEREFORD		**5,405**	5,507	5,439
SALOP		**100**	103	104
SURREY		**552**	585	557
SUSSEX		**2,864**	3,036	2,889
WORCESTER		**2,961**	3,194	3,157
OTHER COUNTIES*		**13**	30	30
TOTAL		**34,744**	36,661	35,676

* Gloucester and Stafford.

Agricultural Returns of England and Wales, 1915.

THE Preliminary Statement of the Agricultural Returns for England and Wales, collected in June last, shows a decrease in the total area under crops and grass of 61,000 acres, of which 33,000 acres represents arable land and 28,000 acres permanent grass. Wheat shows an increase of 363,000 acres, or 20 per cent., as compared with last year, the 2,170,000 acres under this cereal being the largest recorded since 1891; while the increase since 1913 amounts to 469,000 acres, or nearly 28 per cent. Oats have also increased by 158,000 acres. These increases of the two most important corn crops have been obtained mainly by substituting them for barley, beans, peas, and roots. Barley shows a decrease of

Agricultural Returns of England and Wales, 1915; Preliminary Statement for 1915, compiled from the Returns collected on the 4th June; and comparison with 1914.

CROPS.

Distribution.	1915.	1914.	Increase.		Decrease.	
	Acres.	*Acres.*	*Acres.*	*Per Cent.*	*Acres.*	*Per Cent.*
TOTAL AREA (excluding WATER) ..	**37,139,150**	37,139,150	—	—	—	—
TOTAL ACREAGE under all CROPS and GRASS (a)	**27,053,360**	27,114,000	—	—	60,640	0·2
ARABLE LAND	**10,965,640**	10,998,250	—	—	32,610	0·3
PERMANENT GRASS (a) For Hav ..	**4,655,030**	4,785,450	—	—	130,420	2·7
PERMANENT GRASS (a) Not for Hay	**11,432,690**	11,330,300	102,390	0·9	—	—
PERMANENT GRASS (a) TOTAL ..	**16,087,720**	16,115,750	—	—	28,030	0·2
Wheat .. Autumn Sown	**2,029,250**	—	—	—	—	—
Wheat .. Spring Sown	**140,860**	—	—	—	—	—
Wheat .. TOTAL	**2,170,110**	1,807,500	362,610	20·1	—	—
Barley	**1,231,720**	1,504,770	—	—	273,050	18·1
Oats	**2,088,050**	1,929,630	158,420	8.2	—	—
Rye	**47,680**	53,900	—	—	6,220	11·5
Beans	**266,530**	294,020	—	—	27,490	9·3
Peas	**129,380**	168,840	—	—	39,460	23·4
Buckwheat	**2,650**	3,040	—	—	390	12·8
Potatoes	**463,400**	461,620	1,780	0·4	—	—
Turnips and Swedes	**931,760**	1,045,090	—	—	113,330	10·8
Mangold	**413,710**	432,370	—	—	18,660	4·3
Cabbage and Kohl-Rabi	**68,210**	67,940	270	0·4	—	—
Rape	**65,530**	70,460	—	—	4,930	7·0
Vetches or Tares	**109,630**	123,730	—	—	14,100	11·4
Lucerne	**53,000**	53,650	—	—	650	1·2
Hops	**34,740**	36,660	—	—	1,920	5·2
Small Fruit	**74,190**	77,360	—	—	3,170	4·1
CLOVER and ROTATION GRASSES For Hay ..	**1,538,070**	1,554,910	—	—	16,840	1·1
CLOVER and ROTATION GRASSES Not for Hay	**824,300**	826,440	—	—	2,140	0·3
CLOVER and ROTATION GRASSES TOTAL ..	**2,362,370**	2,381,350	—	—	18,980	0·8
OTHER CROPS	**143,340**	145,580	—	—	2,240	1·5
BARE FALLOW	**309,640**	340,740	—	—	31,100	9·1
ORCHARDS (b)	**248,830**	243,110	5,720	2·4	—	—

(a) Excluding Mountain and Heath Land used for grazing (3,764,710 acres in 1915, as compared with 3,781,560 acres in 1914).

(b) Any Crop or Grass grown in Orchards is also returned under its proper heading.

273,000 acres, bringing the total under this crop to the lowest on record. Turnips and swedes have fallen off by 113,000 to 932,000 acres, this being the first occasion on which the total has fallen below a million acres. Hay (whether "seeds" or meadow) has decreased by 147,000 acres. The decrease in hay may largely be attributed to the dry spring, as the area of permanent grass reserved for grazing has increased by 102,000 acres, while clovers and seeds for grazing are about the same as in 1914. The other most important crop for human consumption—potatoes—shows an increase of about 1,800 acres. All other crops, except cabbage and kohl-rabi, show decreases of greater or smaller extent.

The live stock returns show increases among cattle and sheep, but decreases among horses and swine. Horses, many of which have been taken for the army, have fallen in number by 112,000 (or 8 per ceut.), the greatest relative decrease being among horses not used for agricultural purposes. Cows show a decrease of 50,000 from the record figure of 1914, but are still higher than in any other year; all other cattle have increased, and the total number 6,064,000 (186,000 more than in 1914), constitutes the highest recorded. The increase in sheep amounts to 263,000; those above one year (other than breeding ewes) increasing by a third of a million; but an indifferent lambing season is responsible for a reduction of 101,000 in the number of lambs. The decline of 61,000 in pigs is mostly among breeding sows, but the total is well above the ten-year average.

LIVE STOCK.

KIND.	1915	1914.	INCREASE.		DECREASE.	
	No.	*No.*	*No.*	*Per Cent.*	*No.*	*Per Cent.*
Horses used for Agricultural purposes (including Mares for Breeding)	**729,080**	791,300	—	—	62,220	7·9
Unbroken Horses (including Stallions). One year and above	**209,770**	220,570	—	—	10,800	4·9
Unbroken Horses (including Stallions). Under one year	**99,240**	102,110	—	—	2,870	2·8
Other Horses	**249,090**	285,570	—	—	36,480	12·8
TOTAL OF HORSES	**1,287,180**	1,399,550	—	—	112,370	8·0
Cows and Heifers in Milk or in Calf	**2,434,500**	2,484,220	—	—	49,720	2·0
Other Cattle:—Two years and above	**994,330**	952,330	42,000	4·4	—	—
" One year & under two	**1,297,220**	1,174,950	122,270	10·4	—	—
" Under one year ..	**1,338,100**	1,266,440	71,660	5·7	—	—
TOTAL OF CATTLE	**6,064,150**	5,877,940	186,210	3.2	—	—
Ewes kept for Breeding	**6,871,740**	6,838,330	33,410	0·5	—	—
Other Sheep:—One year and above	**3,481,650**	3,151,550	330,100	10·5	—	—
" Under one year ..	**7,169,190**	7,269,810	—	—	100,620	1·4
TOTAL OF SHEEP	**17,522,580**	17,259,690	262,890	1·5	—	—
Sows kept for Breeding	**298,160**	340,380	—	—	42,220	12·4
Other Pigs	**2,121,870**	2,141,100	—	—	19,230	0·9
TOTAL OF PIGS	**2,420,030**	2,481,480	—	—	61,450	2·5

MISCELLANEOUS NOTES.

Notes on Crop Prospects Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for August, 1915, issued by the International Institute of Agriculture, gives estimates of the production of cereal crops this year. The countries for which it is possible to give an approximate estimate of the production are as follows:—In *Europe*—Spain; Great Britain; Ireland; Italy; Russia in Europe (54 governments), Switzerland; in *America*—Canada; United States; in *Asia*—India; Japan; in *Africa*—Tunis. *Wheat.*—The total production in the above-mentioned countries is estimated to amount to 322,813,000 qr. in 1914–15, as compared with 273,896,000 qr. in the same countries in 1913–14, the increase being equal to 17·9 per cent. The area under cultivation was also greater by 8·4 per cent.

Rye.—The estimated production in the specified countries, excluding Great Britain, Canada, India, Japan and Tunis, is placed at 119,984,000 qr. this year, against 101,119,000 qr. last year, or an increase of 18·7 per cent., while the area planted was less by 1·5 per cent.

Barley.—The production in the above countries, excluding Canada and India, is estimated at 116,001,000 qr., or an increase of 19 per cent. compared with last year, when the production was 97,440,000 qr. The area sown showed a decrease of 2·5 per cent.

Oats.—For the above-mentioned countries, excluding Canada, India and Japan, the estimated production is 270,995,000 qr., against 218,296,000 qr. in 1913–14, the increase amounting to 24·1 per cent., while the area planted was practically the same as last year.

France.—The condition of the crops on the 1st August was officially estimated as follows:—Winter wheat, 64 as compared with 68 on the 1st July; spring wheat, 64 against 69; rye, 66 against 71; winter barley, 68 against 73; spring barley, 63 against 69; winter oats, 68 against 71; and spring oats, 65 against 68. (80 = good, and 60 = fairly good). (*The London Grain, Seed and Oil Reporter*, 25th August.)

Holland.—The total production of the crops is estimated as follows:—Wheat, 777,000 qr. as compared with 672,000 qr. last year; barley, 388,000 qr. against 385,000 qr; oats, 1,881,000 qr. against 2,046,000 qr.; rye, 1,601,000 qr. against 1,707,000 qr.; potatoes, 2,224,000 tons against 2,512,000 tons; and sugar-beet, 1,776,000 tons against 1,962,000 tons. (*Bulletin of Agricultural and Commercial Statistics*, August, 1915).

Russia.—An official report on the crop conditions, up to 28th July, stated that, out of 604 districts of European Russia, winter crops were bad in only 7 districts (1·2 per cent.); medium in 7 districts (1·2 per cent.); satisfactory in 116 districts (19·2 per cent.); good in 344 districts (56·9 per cent.); and excellent in 33 districts (5·5 per cent.). The condition of spring crops improved owing to abundant moisture: 191 districts (31·6 per cent.) reported good crops, 256 districts (42·4 per cent.) satisfactory crops, and 39 districts (6·5 per cent) medium crops, while only 21 districts (3·5 per cent.) reported bad crops. (*Broomhall's Corn Trade News*, 25th August.)

United States.—The Crop Reporting Board of the Bureau of Statistics of the Department of Agriculture, in reporting as to crop conditions on

the 1st September, states that the total production of winter wheat is estimated at 659,000,000 bush. as compared with a yield of 684,990,000 bush. last year; spring wheat at 322,000,000 bush. against 206,027,000 bush; maize, 2,985,000,000 bush. against 2,672,804,000 bush.; oats, 1,408,000,000 bush. against 1,141,060,000 bush.; barley, 223,000,000 bush. agaiast 194,953,000 bush.; and linseed, 18,000,000 bush. against 15,559,000 bush.—(*The London Grain, Seed and Oil Reporter*, 8th September).

Australia.—The wheat crop of Western Australia is officially estimated at 18,000,000 bush.—(*Broomhall's Corn Trade News*, 2nd September)

[In 1914-15 the total production was 2,621,325 bush., and in 1913-14 13,331,350 bush,].

Agricultural Conditions in England and Wales on 1st September.

THE Crop Reporters of the Board, in reporting on agricultural conditions in England and Wales on the 1st September, state that the fine weather during the latter half of August greatly assisted the harvesting of the corn crops.

Wheat shows a slight improvement, and the yield should practically reach an average. In most districts considerable progress had been made with the cutting, and much had been carried. In the south of the country harvesting operations were hindered by the wet weather in the first two weeks of the month. In many districts also the corn was badly laid by the heavy rains. Barley has not improved during the month, the yield being anticipated to be slightly worse than was estimated on the 1st August, and about 8 per cent. less than the average. Cntting has been general, but not much had yet been carried. Oats have slightly improved, but are still estimated at abont 7 per cent. below an average yield. In the south much has been cut and carried, and elsewhere cutting has been general. Both barley and oat straw is short. Beans have deteriorated during the month, and have suffered from blight, and peas also show worse prospects than a month ago.

Potatoes are not so promising as at the date of the last report, and the expected yield is slightly lower. Early varieties are light, while from many districts disease is reported.

Turnips and swedes are very variable, average yields being expected in some districts, while in others the plant is patchy, and growth backward. The crop as a whole is anticipated to be some 8 per cent. below the normal. Mangolds have somewhat improved during the month in some districts; and the prospects are promising, and the yield should not be much below the average.

Apples tend to be small, and are not expected to yield an average crop, pears are slightly over average, while the crop of plums is heavy.

The favourable weather of the latter half of the month has effected some improvement in the prospects of the hop crop, especially in the better managed gardens, and where washing has heen continuous, the plant is in a much healthier state. The attacks of aphis have been very persistent, and the crop is expected to be more than 30 per cent. below the average yield.

Pastures have everywhere benefited by the rain, and are full of grass. All classes of stock are doing very well.

Summarising the returns, and expressing an average crop by 100,

the condition of the crops on 1st September indicated probable yields which may be denoted by the following percentages :—Wheat, 100; barley, 92; oats, 93; beans, 94; peas, 94; potatoes, 99; turnips and swedes, 92; mangolds, 98; hops, 67.

Agricultural Labour in England and Wales during August.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st September, the fine weather of the latter part of August assisted harvesting operations, and mitigated the general shortage of labour. Both skilled and casual labour were reported to be deficient, but not to so great an extent as seriously to interfere with the corn harvest. Reference was made in some districts to the employment of women and soldiers on the farms.

The following local summaries give further details regarding agricultural labour in the different districts of England and Wales :—

Northumberland, Durham, Cumberland, and Westmorland.—There was a general shortage in the supply of labour, especially among skilled men, but the essential work was getting done with little delay except in one or two districts. The fine weather during the latter part of August helped considerably as regards harvest work.

Lancashire and Cheshire.—Labour was scarce in most districts. The increased employment of machinery has mitigated to some extent the inconvenience due to the shortage of labour.

Yorkshire.—Labour was still difficult to obtain, and skilled men especially were lacking. The wages were still high.

Shropshire and Stafford.—Labour for the most part was still very scarce.

Derby, Nottingham, Leicester, and Rutland.—Labour, both skilled and casual, was generally deficient. Women and schoolboys have been helping with the harvest in some districts.

Lincoln and Norfolk.—The shortage in the supply of labour, which was general, was not being felt to any serious extent on the whole. High wages are being paid for the harvest, and with favourable weather the crops will be safely gathered.

Suffolk, Cambridge, and Huntingdon.—Labour was deficient, but not very seriously so in most places, and some help was being obtained from soldiers. Increased wages for harvesters were being paid in several districts.

Bedford, Northampton, and Warwick.—The supply of labour was, generally speaking, deficient.

Buckingham, Oxford, and Berkshire.—On the whole the labour supply was short, but, thanks partly to the fine weather, farmers have got on fairly well.

Worcester, Hereford, and Gloucester.—Labour was deficient generally, but harvest work was getting done. Female labour was utilised in some cases.

Cornwall, Devon, and Somerset.—Labour was deficient in most places, especially for casual work. Farmers were, however, managing fairly well, the dry weather having facilitated harvesting.

Dorset, Wiltshire, and Hampshire.—Labour was very deficient, casual labour being difficult to get, but the deficiency was being made up to a certain extent by the employment of women and soldiers. Wages have increased. The fine weather towards the end of the month enabled the harvesting operations to be carried on with a minimum of labour.

Surrey, Kent, and Sussex.—There was a deficiency of labour in most districts, but it was not stated that work was backward anywhere on that account.

Essex, Hertford, and Middlesex.—Labour was scarce, but farmers were getting through the work fairly well. In south-west Essex market gardeners were suffering as they could not get enough men to keep the crops clean.

North Wales.—A shortage of labour was reported from most districts, but on the whole the deficiency did not appear to be serious, and harvesting was well in hand.

Mid Wales.—On the whole there was a scarcity of labour, but serious shortage was reported only from North Montgomery.

South Wales.—There was a general complaint of shortage, more particularly in casual labour.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st September, 1915, certain diseases of animals existed in the countries specified:—

Austria (on the 4th Aug.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (month of June).
Anthrax, Foot-and-Mouth Disease (1,201 outbreaks), Glanders and Farcy, Swine Erysipelas, Swine Fever.

France (for the period 8th—21st Aug.).
Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox.

Germany (for the period 15th—31st July).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (month of July).
Anthrax, Foot-and-Mouth Disease (129 outbreaks), Foot-rot, Swine Erysipelas.

Hungary (on the 4th Aug.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Italy (for the period 9th—15th Aug.).
Anthrax, Blackleg, Foot-and-Mouth Disease (506 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosis.

Norway (month of July).
Anthrax, Blackleg.

Rumania (for the period 9th July—5th Aug.).
Anthrax, Foot-and-Mouth Disease, Glanders and Farcy, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Russia (month of March).
Anthrax, Foot-and-Mouth Disease (50,278 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies; Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (month of June).
Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (month of July).
Anthrax, Blackleg, Swine Erysipelas, Swine Fever.

Switzerland (for the period 9th—15th Aug.).
Anthrax, Blackleg, Foot-and-Mouth Disease (37 " étables " entailing 3,375 animals, of which 8 " étables " were declared infected during the period), Swine Fever.

No further returns have been received in respect of the following countries :—Belgium, Bulgaria, Montenegro, Serbia.

The Weather in England during August.

District.	Temperature. Daily Mean.	Temperature. Diff. from Average.	*Rainfall. Amount.		*Rainfall. Diff. from Average.	No. of Days with Rain.	Bright Sunshine. Daily Mean.	Bright Sunshine. Diff. from Average.
Week ending Aug. 7th :	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours
England, N.E. ...	58·8	+0·1	0·76	19	+ 1	6	3·3	−2·3
England, E.	61·8	+1·3	1·05	27	+15	6	5·0	−1·2
Midland Counties ...	59·9	+0·1	1·24	32	+18	6	3·1	−2·5
England, S.E.... ...	61·7	+0·2	0·66	17	+ 5	5	3·8	−2·6
England, N.W. ...	58·3	−0·7	1·35	34	+14	5	2·0	−3·4
England, S.W. ...	59·7	−0·2	1·12	28	+11	5	2·9	−3·2
English Channel ...	60·8	−0·9	0·59	15	+ 2	5	4·8	−3·3
Week ending Aug. 14th .								
England, N.E.... ...	60·9	+2·5	1·00	25	+10	5	4·9	−0·5
England, E.	62·6	+2·4	0·69	18	+ 6	5	4·7	−1·5
Midland Counties ...	61·7	+2·3	0·69	18	+ 4	5	5·1	−0·5
England, S.E.... ...	63·0	+1·7	0·47	12	0	4	5·1	−1·4
England, N.W. ...	60·5	+1·9	0·82	21	+ 1	5	4·8	−0·5
England, S.W. ...	62·0	+2·4	0·77	20	+ 3	6	5·6	−0·6
English Channel ...	62·7	+0·9	0·55	14	0	4	7·1	−1·1
Week ending Aug. 21st:								
England, N.E. ...	57·8	−0·2	0·27	7	− 8	3	3·9	−1·3
England, E.	58·4	−1·4	0·49	12	− 2	2	5·4	−0·7
Midland Counties ...	58·3	−0·8	0·27	7	− 8	2	4·4	−1·2
England, S.E	59·1	−2·0	0·31	8	− 6	3	6·4	−0·2
England, N.W. ...	57·9	−0·4	0·67	17	− 3	2	5·5	+0·4
England, S.W. ...	58·6	−0·7	0·11	3	−16	1	8·3	+2·1
English Channel ...	60·3	−1·4	0·00	0	−15	0	10·5	+2·6
Week ending Aug. 28th :								
England, N.E. ...	59 9	+2·4	0·29	7	− 9	1	7·3	+2·3
England, E.	60·3	+0·9	0·03	1	−13	1	7·3	+1·5
Midland Counties ...	59·1	+0·7	0·15	4	−13	1	6·6	+1·4
England, S.E.... ...	61·2	+0·6	0·00	0	−16	0	7·3	+1·1
England, N.W. ...	58·9	+1·0	0·29	7	−16	1	5·4	+0·6
England, S.W. ...	60·0	+1·1	0·03	1	−21	1	7·6	+1·7
English Channel ...	62·3	+0·9	0·00	0	−15	0	9·9	+2·7

* 1 inch = 25·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	AUGUST.		EIGHT MONTHS ENDED AUGUST.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	25	36	418	518
Animals attacked	27	42	478	564
Foot-and-Mouth Disease:—				
Outbreaks	—	3	—	14
Animals attacked	—	17	—	91
Glanders (including Farcy):—				
Outbreaks	4	5	36	73
Animals attacked	6	7	65	219
Parasitic Mange:—				
Outbreaks	45	18	*580	1,521
Animals attacked	89	20	*1,260	2,633
Sheep-Scab:—				
Outbreaks	2	3	161	153
Swine Fever:—				
Outbreaks	246	222	2,993	2,821
Swine Slaughtered as diseased or exposed to infection ...	982	1,421	13,342	28,939

* Figures for five months only, the Parasitic Mange Order of 1911 having been suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	AUGUST.		EIGHT MONTHS ENDED AUGUST.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	—	—	1	1
Animals attacked	—	—	1	1
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	76
Animals attacked	—	—	—	957
Glanders (including Farcy):—				
Outbreaks	—	—	1	—
Animals attacked	—	—	3	—
Parasitic Mange:—				
Outbreaks	9	7	53	62
Sheep-Scab:—				
Outbreaks	22	15	290	390
Swine Fever:—				
Outbreaks	13	16	175	158
Swine Slaughtered as diseased or exposed to infection ...	90	107	1,000	819

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in August and July, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	August. First Quality.	August. Second Quality.	July. First Quality.	July. Second Quality.
FAT STOCK :—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle :—	s. d.	s. d.	s. d.	s. d.
Polled Scots	13 4	12 3	13 4	12 4
Herefords	13 2	12 0	13 4	12 0
Shorthorns	13 3	12 2	13 2	12 1
Devons	13 4	12 5	13 4	12 0
Welsh Runts	13 3	12 7	13 3	12 7
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	10¾	9¾	10¾	9¾
Sheep :—				
Downs	11	10¾	11	10
Longwools	10¼	9½	10¼	9¼
Cheviots	11	10	11¼	10
Blackfaced	10¼	9¼	10¼	9¼
Welsh	10½	9½	10¼	9¼
Cross-breds	11	10	10¾	10
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs :—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	9 9	9 3	9 7	9 0
Porkers	10 2	9 9	9 11	9 5
LEAN STOCK :—	per head.	per head.	per head.	per head.
Milking Cows :—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	26 17	22 2	26 6	21 10
,, —Calvers ...	25 7	21 5	24 12	20 13
Other Breeds—In Milk ...	24 4	19 17	24 3	19 9
,, —Calvers ...	19 5	17 17	18 0	16 10
Calves for Rearing	3 3	2 8	3 5	2 10
Store Cattle :—				
Shorthorns—Yearlings ..	13 17	11 15	13 9	11 5
,, —Two-year-olds..	19 6	16 19	18 9	16 2
,, —Three-year-olds	25 18	22 5	23 19	20 18
Herefords —Two-year-olds..	21 19	18 15	21 0	17 5
Devons— ,,	19 16	17 12	18 10	16 8
Welsh Runts— ,,	19 10	17 15	17 10	16 18
Store Sheep :—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	45 5	39 2	44 1	36 8
Store Pigs :—				
8 to 12 weeks old	28 1	22 2	26 11	21 1
12 to 16 weeks old	44 0	33 11	41 5	32 1

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in August, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham.	Leeds.	Liverpool.	London.	Manchester.
		per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.
BEEF:—						
English	1st	87 6	86 6	86 6	90 6	85 0
	2nd	84 6	84 0	84 0	85 0	81 6
Cow and Bull	1st	79 6	79 6	77 6	77 0	76 6
	2nd	74 6	72 6	71 0	72 6	71 6
Irish: Port Killed	1st	—	83 0	85 0	87 6	83 0
	2nd	—	79 6	80 0	82 0	78 0
Argentine Frozen—						
Hind Quarters	1st	77 0	78 6	76 0	77 0	76 0
Fore ,, ...	1st	71 6	71 6	66 6	66 6	66 6
Argentine Chilled—						
Hind Quarters	1st	86 6	82 6	83 0	86 6	83 0
Fore ,, ...	1st	71 6	69 0	70 0	69 0	70 0
Australian Frozen—						
Hind Quarters	1st	75 0	74 0	76 6	75 0	76 6
Fore ,, ...	1st	70 0	69 0	67 0	67 6	67 0
VEAL:—						
British	1st	86 6	80 6	84 6	96 0	83 0
	2nd	80 6	74 6	74 6	87 6	76 0
Foreign...	1st	—	—	—	91 0	—
MUTTON:—						
Scotch	1st	—	—	—	93 6	89 0
	2nd	—	—	—	88 6	86 6
English...	1st	87 6	90 0	—	90 0	85 6
	2nd	76 0	85 6	—	83 6	80 6
Irish: Port Killed	1st	—	—	84 0	86 6	83 0
	2nd	—	—	79 6	81 6	76 0
Argentine Frozen	1st	63 6	63 6	63 0	66 0	63 0
Australian ,, ...	1st	60 0	60 0	59 6	62 6	59 6
New Zealand ,, ...	1st	68 6	—	—	68 0	—
LAMB:—						
British	1st	87 6	89 0	88 6	95 6	92 6
	2nd	84 0	84 0	80 6	88 0	88 0
New Zealand	1st	81 0	81 0	79 6	78 6	79 6
Australian	1st	76 6	73 6	73 6	75 0	73 6
Argentine	1st	75 0	71 6	74 6	74 0	74 6
PORK:—						
British	1st	84 6	78 0	78 0	85 0	76 0
	2nd	81 6	74 0	71 0	80 0	69 6
Foreign...	1st	—	—	—	—	—

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in August, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Bristol.		Liverpool.		London.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	17 0	15 6	—	—	16 9	15 9
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	157 6	152 0	157 0	154 0	158 0	153 0
" Factory	140 6	135 0	138 0	134 0	144 0	137 0
Danish...	—	—	172 6	169 6	172 0	168 0
French...	—	—	—	—	146 6	140 6
Russian	139 6	132 6	138 6	134 6	135 0	130 6
Australian	—	—	—	—	142 0	138 0
New Zealand	—	—	—	—	—	—
Argentine	—	—	—	—	148 0	144 0
CHEESE:—						
British—						
Cheddar	88 0	76 0	96 6	92 6	93 0	85 0
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	81 0	77 0	89 0	81 0
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	78 0	75 0	76 6	73 6	75 6	72 0
BACON:—						
Irish (Green)	*104 6*	*101 0*	*102 0*	*98 0*	*102 0*	*98 0*
Canadian (Green sides)	89 0	85 0	88 6	78 6	90 0	86 0
HAMS:—						
York (Dried or Smoked)	120 0	116 0	—	—	120 0	116 0
Irish (Dried or Smoked)	—	—	—	—	121 0	111 0
American (Green) (long cut)	72 6	70 0	72 6	69 0	70 6	67 0
EGGS:—	per 120.	per 120.	per 120	per 120.	per 120.	per 120.
British...	14 9	13 11	—	—	15 10	15 0
Irish	14 1	13 10	14 3	13 3	14 10	14 4
Danish...	—	—	—	—	16 1	14 6
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
Early Eclipse... ...	105 0	90 0	—	—	88 6	80 0
Other First Earlies ..	92 6	77 6	81 6	76 6	81 0	73 6
British Queen ...	98 6	82 6	101 6	93 6	87 6	80 0
HAY:—						
Clover	—	—	*142 6*	*112 6*	*117 0*	107 6
Meadow	—	—	—	—	108 0	98 0

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	Wheat.						Barley.						Oats.					
	1913.		1914.		1915.		1913.		1914.		1915.		1913.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Jan. 2...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
,, 9...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
,, 16...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
,, 23...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
,, 30...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
,, 13...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
,, 20...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
,, 27...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
,, 13...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
,, 20...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
,, 27...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3...	31	4	31	6	54	6	27	0	25	6	31	9	19	2	18	5	30	6
,, 10...	31	3	31	5	54	9	27	8	26	8	31	3	19	2	18	4	30	4
,, 17...	31	6	31	7	55	4	26	11	25	4	30	10	18	10	18	4	30	5
,, 24...	31	8	31	9	56	5	26	7	26	6	31	5	19	3	18	5	30	11
May 1...	32	2	31	9	58	3	25	11	26	0	32	7	19	6	18	5	31	5
,, 8...	32	6	32	2	60	5	25	9	25	6	33	3	19	6	18	9	32	4
,, 15...	32	10	32	7	61	7	25	4	26	3	34	0	19	9	18	11	32	5
,, 22...	32	10	33	0	62	0	25	3	25	10	34	1	19	11	19	0	32	8
,, 29...	32	7	33	9	61	11	26	1	26	1	34	8	20	1	19	4	32	7
June 5...	32	10	34	0	61	9	26	2	25	11	35	4	19	8	19	4	32	5
,, 12...	32	8	34	1	60	1	24	7	24	11	34	5	20	2	19	8	32	4
,, 19...	32	8	34	1	56	1	23	10	25	10	34	3	19	8	19	9	31	9
,, 26...	32	8	34	3	52	0	24	3	25	4	34	4	19	1	20	0	31	9
July 3...	33	1	34	4	49	5	25	2	24	6	35	3	21	0	19	9	31	1
,, 10...	33	4	34	2	50	1	25	10	24	9	34	7	19	4	20	0	31	6
,, 17...	33	6	34	1	52	7	24	9	24	2	35	8	20	5	19	10	31	6
,, 24...	33	10	34	0	53	10	24	1	24	7	35	10	20	8	19	9	32	1
,, 31...	34	1	34	2	55	3	24	5	25	9	36	1	20	3	19	8	31	1
Aug. 7...	34	1	34	9	55	4	24	9	25	2	35	7	19	0	19	1	31	5
,, 14...	34	3	40	3	55	2	24	7	29	4	37	0	18	7	25	1	31	7
,, 21...	33	7	38	9	54	3	26	5	29	10	39	4	18	8	24	3	31	4
,, 28...	32	7	36	2	51	11	29	0	30	3	38	3	17	10	23	5	30	0
Sept. 4...	31	11	36	5	45	3	30	11	30	6	38	1	17	8	23	9	26	10
,, 11...	31	9	37	10	43	0	31	5	29	11	37	11	18	0	23	11	26	8
,, 18...	31	7	38	3			30	9	29	5			17	11	23	8		
,, 25...	31	6	37	6			30	1	29	3			17	9	23	3		
Oct. 2...	31	3	37	1			29	9	29	1			17	10	22	9		
,, 9...	31	0	36	8			29	1	28	10			17	10	22	5		
,, 16...	30	11	36	7			28	8	28	8			17	9	22	4		
,, 23...	30	7	37	2			28	7	28	7			18	0	22	5		
,, 30...	30	1	37	10			28	2	28	3			17	9	23	7		
Nov. 6...	30	0	38	8			28	1	28	6			17	9	23	7		
,, 13...	30	1	39	8			27	8	29	0			17	11	24	8		
,, 20...	30	4	41	0			27	5	29	8			18	1	25	5		
,, 27...	30	9	41	11			27	0	30	3			18	4	25	8		
Dec. 4...	31	2	42	2			26	8	30	2			18	4	25	9		
,, 11...	31	2	42	1			26	5	29	11			18	6	25	9		
,, 18...	31	2	42	7			25	11	29	8			18	5	25	9		
,, 25...	31	0	43	3			25	10	29	9			18	4	25	11		

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of August, 1914 and 1915.

—	WHEAT.		BARLEY.		OATS.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
London	36 6	54 0	29 4	40 11	24 1	31 11
Norwich	35 11	54 4	27 5	—	21 7	29 0
Peterborough	37 2	52 4	28 3	37 7	21 10	31 0
Lincoln	35 6	53 11	27 8	36 7	21 5	32 4
Doncaster	36 4	53 7	—	35 9	21 8	31 10
Salisbury	35 2	54 11	28 6	36 11	22 8	30 11

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous—

The Influence of Weather Conditions upon the Amounts of Nitric Acid and of Nitrous Acid in the Rainfall at and near Melbourne, *V. G. Anderson.* (Quart. Jour. Roy. Met. Soc., April, 1915.) [551.5.]

Cultivation of Seaweed in Ireland, *G. H. Pethybridge.* (Dept. Agric. and Tech. Instr. Ireland Jour., April, 1915.) [63.165.]

The Utilisation of Raw Mineral Phosphates as Manure. (Bull. Imperial Inst., Vol. XIII., No. 1, January–March, 1915.) [63.1672.]

Availability of the Nitrogen in Pacific Coast Kelps, *G. R. Stewart.* [63.165.] Organic Constituents of Pacific Coast Kelps, *D. R. Hoagland.* [63.165.] (Jour. Agric. Research [U.S.A.], Vol. IV, No. 1, April, 1915.)

The Industrial Uses of Radium, *T. Thorne Baker.* (Jour. Roy. Soc. Arts, 16 April, 1915.) [63.168.]

Agriculture in Hungary. (Estate Mag., June, 1915.) [63(439).]

Field Crops—

Sudan Grass or Garawa, *R. Hewison.* (Field, 24 April, 1915.) [63.33(*d*).]

Investigations of Vegetable Drugs and Poisonous Plants. (Bull. Imperial Inst., Vol. XIII., No. 1, January–March, 1915.) [63.348; 63.25.]

Sudan Grass, *J. A. T. Walters.* (Rhodesia Agric. Jour., April, 1915.) [63.33(*d*).]

The Empire's Resources in Paper-making Materials, *S. Chas. Phillips.* (Jour. Roy. Soc. Arts, 21 May, 1915.) [676.]

Notes on the Hydrocyanic-Acid Content of Sorghum, *J. J. Willaman* and *R. M. West.* (Jour. Agric. Research [U.S.A.], Vol. IV., No. 2, May, 1915.) [63.33(*d*).]

Some Minor Farm Crops, II. I. Peppermint. II. Lavender. III. Poppies. IV. Celery. *G. H. Grellier* and *J. Stephenson.* (Jour. Roy. Agric. Soc. Eng., Vol. 75, 1914.) [63.511; 63.345; 63.348.]

Horticulture—

Lawns and their Upkeep, *J. Macdonald.* [63.52.] A Guide to the Literature of Pomology, *E. A. Bunyard.* [63.41(*a*); 01.] (Jour. Roy. Hort. Soc., Vol. XL., Part 3, April, 1915.)

Plant Diseases—

Blister Disease of Fruit Trees, *G. Massee.* (Roy. Bot. Gard. Kew, Bull. Misc. Inform., No. 3, 1915.) [63.24–41.]

(4069.) Wt. P. 16—9. 7,250. 9/15. J. T. & S., Ltd.

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 7.

OCTOBER, 1915.

THE MANURIAL SITUATION AND ITS DIFFICULTIES.*

JAMES HENDRICK, B.Sc., F.I.C.,

Professor of Agriculture in the University of Aberdeen.

FIFTY years ago the manure industry was comparatively small and local. Its chief centre and market was in Britain. Before the Franco-German War of 1870 the only manure in which there was a really great overseas trade was guano. Since that date the manufacture of, and commerce in, fertilising materials have continuously extended at a rapid rate till in recent times the supply of manures has become a great world industry, employing an army of workers and an immense amount of capital in all the continents, and keeping busy a great navy of ships on all the seas.

Before 1870 the whole world's shipments of manures probably never reached a million tons in any one year. In 1912, on the other hand, there were produced over 6¾ million tons of mineral phosphates alone, of which by far the greater part was shipped overseas from the United States, North Africa, and certain Pacific Islands, to Europe, Japan, Australia, etc. Of nitrate of soda in 1913 there was shipped from Chile 2¾ million tons, and in the same year Germany exported over 2 million tons of potash manures. In addition, smaller but still very large quantities of basic slag, sulphate of ammonia, superphosphates, bones, guanos, and other manures were shipped overseas as articles of international commerce.

Thus, the international fertiliser industry now involves annual shipments of many million tons, and the production and use throughout the world of a still greater amount of material.

* A paper read by Professor Hendrick at the Meeting of the British Association at Manchester in September.

The British fertiliser market, which was at one time the chief and, indeed, the only great market, is now a comparatively small item in the world's trade. The rapid growth of the German market, for instance, is shown by the following figures giving the total consumption of artificial manures in Germany in certain years :—

1890.	1900.	1910.	1912.
1,600,000	*3,088,669*	*5,906,530*	*7,352,700 metric tons.*

It is estimated that in 1912 German farmers paid about £30,000,000 for fertilisers.

It is more difficult to get complete figures for the United Kingdom, but there has been no similar increase in the consumption of fertilisers during the same period. For the past 30 to 40 years our consumption has been almost stationary in the case of certain leading manures like nitrate of soda and bones, while in other cases, such as superphosphate and basic slag, there has been a gradual, but not a very rapid, increase. The artificial manures used in the United Kingdom in 1907 were valued at a little under 15 million pounds.

The outbreak of war has naturally caused an extraordinary dislocation of an industry of such an international character as that of the supply of manures.

(1) It has stopped trade between belligerent countries, and has, therefore, cut off our supply of potash manures. Nearly the whole supply of potash manures for this and other countries was derived from the German potash mines. Only comparatively small supplies are derived from seaweed and other sources. Enemy countries will have plentiful supplies of potash manures, but the great export of such manures by Germany, even to neutral countries like America, has been almost entirely stopped.

(2) The war has put great difficulties in the way of oversea transport, and has caused a considerable rise in freights. It has, therefore, restricted the supply, or caused a great rise in the price, of all manurial materials which are imported from abroad. In the case of mineral phosphates the freights are now greater than the original cost of the material. Our supplies of nitrate of soda, bones and guanos, are all interfered with by the rise in freights, and the difficulty of getting shipment. On the other hand, the supply of such materials is largely cut off in the case of enemy countries.

(3) The withdrawal of men for military service has put difficulties in the way of the production of certain articles.

For example, the North African phosphate mines are hampered by the withdrawal of men first for the French and later for the Italian Army. In our own country the withdrawal of men and the restriction and increased cost of internal transport are adding to the difficulties of fertiliser manufacturers, *e.g.*, the supply of sulphuric acid necessary for the manufacture of dissolved manures is said to be restricted by the difficulty of getting the chemical plumbers required for the repair of acid chambers.

(4) The war has seriously interfered with international credit and exchange, and has thus in many ways, direct or indirect, hampered international trade in manurial materials, and in many cases caused serious delay in obtaining supplies. In recent times the German market has become a far more important market for many of the chief fertiliser materials than the British, and, when it was completely shut off from overseas exchange, serious interruptions and dislocations occurred which greatly affected British manufacturers.

We may next consider how all this will affect the supply of manures to the British farmer during the coming season, and how he is to meet the abnormal conditions in which he will be placed. It is most important that the agricultural production of the country should be not merely maintained, but increased in every possible way. Farmers should, therefore, (1) continue to use fertilisers in undiminished amount, so far as that is practically possible, (2) prevent waste of natural fertilising materials, and (3) make use of our home resources in fertilising materials as far as possible. This will involve some adjustments of their usual practices and routine, and it will be the duty of educational bodies and agricultural experts to give them all the advice and help they can as to how best to make such adjustments.

Of the four important kinds of manurial materials (nitrogenous, phosphatic, potassic, and calcareous), there is only one, the potassic, of which there will be a serious scarcity, and it seems almost certain that greater difficulty will arise from want of labour than from want of raw material. Several of the leading manure manufacturers in Scotland have been good enough to provide information on various points connected with the supply of manures for next season. The information so obtained has been of great assistance in drawing up the following statement. Probably what applies to Scotland will also apply in nearly every respect to the rest of the United Kingdom. The manufacturers who have been consulted are all

agreed that, except in the case of potash, the supply of raw material will not be the most serious difficulty, but that the want of labour will cause much greater trouble. This will be felt in the manufacturing departments, but will be even more serious in connection with carting and transport of materials. It is anticipated that the most serious difficulty will be not in manufacture but in distribution. It is, therefore, very important that farmers should not wait till spring to order their manures, but should spread their orders over as long a period as possible. In spring there is always congestion and some difficulty in supplying all customers promptly, and unless farmers get in a large part of their requirements early it will be impossible for the manufacturers to deliver the goods next season.

There should be no insuperable difficulty about this if farmers will give the matter a little attention and move in good time. With the exception of soluble nitrogenous manures, which may be washed away in the drainage, there is no loss when manures are applied early. Many farmers think that soluble phosphates are liable to be lost if applied in autumn or winter. This is not the case, as such phosphates are entirely fixed in the soil and suffer no loss in the drainage even when large quantities are applied. There are, no donbt, objections to farmers obtaining their manures early and storing them, but superphosphates, basic slag, bone meal and bone flour, can all be obtained early and applied at once, especially to grass land and corn crops. In the case of crops like turnips and potatoes, which are grown in drills, there is some advantage in placing the manure in the bottom of the drill, so that it may not be advisable to sow the manure early for these. In any case it will greatly help to relieve the situation if as much manure as possible is ordered early.

The scarcity of labour may also, to some extent, restrict supplies, though the danger here is not so serious. This is an additional reason, however, why consumers should order early. The man who leaves his order till the last moment will run a risk of finding that he cannot get supplies of certain articles at all.

Nitrogenous Manures.—It is probable that there will be sufficient supplies of nitrogenous manures. In normal times we export over three-fourths of our total production of sulphate of ammonia. Such export will now be restricted, as this and other fertilisers can only be exported under license. Our total production of sulphate of ammonia exceeds 400,000 tons per annum, so that there should be sufficient of this valuable

fertiliser available to meet even greatly increased consumption. It is probable that the price will be a little higher than in pre-war times owing to the enhanced price of sulphuric acid, and the increased cost of labour and transport, but it is not likely that the price will be excessive.

There should also be considerable supplies of nitrate of soda. Normally, the German market consumes many times as much of this substance as the British. The Belgians were also heavy consumers of nitrate. These great markets are now closed and practically unlimited supplies are nominally available for the British market. Freights from Chile have, however, risen to an almost prohibitive level. Therefore, though there is plenty of nitrate available in South America, it is probable that the price in this country will be high. At present the price of nitrogen per unit is much higher in nitrate of soda than in sulphate of ammonia. Great supplies of nitrate will of course, be required for the explosives industry.

In addition to these two leading nitrogenous manures there will also be supplies of others, such as calcium cyanamide and nitrate of lime. There seems no reason to suppose that the supplies of these will be seriously restricted. At present, calcium cyanamide (nitrolim) is considerably the cheapest of the concentrated nitrogenous manures per unit of nitrogen.

Phosphatic Manures.—It seems probable that manufacturers will be able to obtain sufficient quantities of raw phosphates, though at greatly enhanced prices. For a time after the outbreak of war there was serious difficulty in obtaining supplies, as contractors for these and other materials almost everywhere took steps to get their contracts cancelled. Further, as the German market was the principal one for high-grade Florida phosphates, many of the mines closed down when this market was cut off. To a large extent, the difficulties seem now to have been adjusted, but the price of rock phosphates will be considerably raised owing to the great rise in freights. Thus, before the war the freight from Florida was 15*s.* to 20*s.* per ton. It is now 50*s.* to 60*s.* per ton, and it is difficult to get bottoms even at these rates.

The cost of sulphuric acid will also be much increased owing to the rise in the price of pyrites, the increased cost of labour, and the great demand for acid for the manufacture of war materials. There seems also to be some uncertainty as to the supply of acid. The demand for Government purposes has not merely doubled or trebled, but has increased manyfold, and it will continue to increase with the increased production

of munitions. Though active steps have been and are being taken to increase the supply of acid, and many manufacturers think there will be a sufficient supply, there are elements of doubt and uncertainty in the problem. It is not impossible that there may be a shortage for the manufacture of superphosphates and of other dissolved manures. If so, there will be a more or less serious scarcity of superphosphate. In any case the price of superphosphate will be greatly increased. If soluble phosphate is not scarce it will, at any rate, be dear.

On the other hand, there should be large supplies of basic slag available. As in the case of sulphate of ammonia, part of the basic slag produced in this country is normally exported. Such exportation is, at present, largely restricted, as it is forbidden except under license. Our recent production of basic slag has been a little over 400,000 tons per annum, while our production of superphosphate exceeds 800,000 tons per annum, of which about one-tenth is exported. There are normally available for home consumption about 750,000 tons of superphosphate in this country. The home consumption of basic slag on the other hand is about 250,000 tons per annum. These figures show that if there is a really serious deficiency of superphosphate it cannot be met by the use of slag. Even if we use at home the whole of the slag at present exported from this country, it cannot do more than replace a fraction of the superphosphate at present consumed.

Even if there is a serious deficiency of superphosphate owing to want of acid and labour, there is no reason why our soils should suffer from lack of phosphatic fertiliser so long as we can obtain supplies of raw mineral phosphates. Finely-ground Tunis and Algerian phosphates (and to these may be added Egyptian phosphates, which are now also on the market in bulk) are far more valuable as manures than is generally realised. They can be used for all the purposes for which basic slag is employed, and will give, weight for weight, of phosphoric acid, only a slightly inferior result. As they are cheaper per unit of phosphate, a greater weight of phosphate can be applied for the same money than in the case of slag, and still more than in the case of superphosphate. Even apart from war exigencies, ground mineral phosphates deserve far more attention for direct application as manure than they receive.

Potassic Manures.—As our chief supplies of potash manures are cut off, the most important question we have to consider is how we can maintain our crops without supplies of German potash salts. Various recommendations have been made as to obtaining potash from waste organic materials like hedge

clippings, bracken, and waste timber, bark, twigs, and similar forestry by-products. All of these are useful, and where it is practicable to obtain ash from such materials they should not be neglected. No large supplies, however, need be looked for from these sources. A more hopeful source of potash supply is to be found in seaweed. Even in peace time a certain amount of seaweed has always been burnt in Scotland and Ireland, and the ash, or kelp, sold to chemical manufacturers, who extract potash compounds and iodine from it. The production of kelp is a poor, badly-organised industry, found only among the crofters of the Islands and West Coasts of Scotland and Ireland. It is difficult to revive this decayed industry, but the writer believes that under present conditions greatly increased supplies of potash might profitably be obtained from seaweed.

Before leaving this subject it may, perhaps, be pointed out that the direct use of seaweed as manure is well worth the consideration of all farmers within reach of the coast. As potash has risen to about four times its pre-war price, seaweed is much more valuable per ton as manure than it was, and it is better worth while to incur some expenditure in saving and carting it to the land.

An immense amount of potash is at present lost in liquid manure. It is not generally realised that liquid manure is far richer in potash than in any other manurial constituent. As a result of 35 analyses of liquid manure* obtained from farms in the north-east of Scotland, the writer found that the percentage content of potash is, on the average, more than twice the percentage of nitrogen. There are, naturally, great variations in composition, and in exceptional cases the nitrogen was higher than the potash, but in nearly all cases the potash was higher than the nitrogen and generally very much higher.

Most of the potash in the food of stock is excreted in the urine, and the liquid which drains away from the dung heap is very rich in potash. If all the urine of stock, and all the liquid manure which drains away from dung heaps were saved and used as manure, it would largely do away with the necessity for the use of special potash manures, and would also supply much nitrogen to the soil. With potash at its present high price, the waste of liquid manure is almost criminal.

Liquid manure can be applied to the land in various ways. It may be soaked up in absorbent organic materials like peat moss, leaves, bracken, and other waste vegetable material, where such can be obtained, or it may be sprayed direct on the

* See this *Journal*, July, 1915, p. 346.

fields in the form of liquid. In any case it should be well distributed. Part of the prejudice which seems to exist against it in the minds of farmers appears to have been caused by its excessive use on limited areas easy of access. Farmyard manure itself will do harm if applied in excess to limited portions of land, and no farmer thinks of applying it only to a few spots which he can get at easily.

Other methods which may be used to help the potash supply on certain soils are the use of soda salts, such as common salt, and nitrate of soda, and the use of lime. These manures are of use only on soils which naturally contain considerable supplies of potash locked up in insoluble forms.

Calcareous Manures.—There is no danger of the supply of lime being cut off owing to the war, but there is a danger that owing to scarcity of labour and difficulties of transport supplies may not easily be obtained when they are wanted, especially if farmers do not order early and leave as large a margin of time as possible for obtaining delivery. In many districts of the country lime, whether in the form of carbonate or of burnt lime, is far too little used. In order to increase our crops during this time of stringency and high prices, greatly increased amounts of carbonate of lime and of burnt lime should be used over large parts of the country.

THE WORK OF EDUCATED WOMEN IN HORTICULTURE AND AGRICULTURE.*

MRS. ROLAND WILKINS.

(ii.) SALARIED POSTS.—For a woman who had had a training in gardening, the choice in posts before the outbreak of war was not very great. Commercial gardens did not afford openings to women workers to any extent, and, therefore, posts as gardeners were practically confined to those offered by private establishments or educational and other institutions. They can be divided into Head-Gardeners, Companion-Gardeners, Under-Gardeners or Improvers, Teachers of Gardening in Schools or Institutions, and Jobbing Assistants.

Head-Gardeners. — "Head - gardener," left unqualified, is an ambiguous term. It may mean the person who controls a big establishment with a considerable amount of glass, and a large number of under-gardeners; or it may be merely the person in charge of a smaller garden, with the help of a man or boy, and no glass beyond perhaps a vinery and a greenhouse for bedding plants and tomatoes. Some idea

* Continued from the *Journal* for September, 1915, p. 554.

of the relative numbers thus employed is given by the following figures. Out of 71 cases investigated :—

11 were single-handed.	
38 had 1 or 2 assistants under them.	
16 ,, 3 or 4 ,, ,,	
6 ,, 5 to 9 ,, ,,	

In 12 cases, one of the under-gardeners was a woman.

The following statistics have been compiled from records of nearly 100 cases of trained women holding posts as head gardeners :—

Length of College Training.

Less than 1 year	2 per cent.
1 to 2 years	21 ,,
2 ,, 3 ,,	55 ,,
3 years	21 ,,

Salaries.

Receiving a weekly wage only	28 per cent.
Resident, or receiving board and lodging with a salary	55 ,,
Receiving a salary with furnished cottage or rooms, and often vegetables, fruit, coal and light	17 ,,

The highest salary received was £140,* the lowest was £52.

31 per cent. received from	£52 to £70.
46 ,, ,,	£70 ,, £90.
12 ,, ,,	£90 ,, £100.
11 ,, ,,	over £100.

The following table shows the wages received up to 1914 after a given number of years' experience, whether this was obtained as under-gardener, or in previous posts as head-gardener :—

Length of Experience.	*Average Salary.*
Under 3 years' experience, average salary	£80†
3 years' experience, average salary	75 5*s.*
4 ,, ,, ,,	78
7 ,, ,, ,,	78
9 ,, ,, ,,	81 10*s.*
10 ,, ,, ,,	87 10*s.*
Over 10 years ,, ,,	90

* In order to give the remuneration in equal terms, the value of board and lodging has been taken at £40 a year; and of lodging, with the other items named, at £20. These figures are only correct assuming that this represents the average amount which those receiving wages only would have to pay out of these wages for board and lodging. A separate compilation, made from those receiving weekly salaries only, gives the average amount per annum at £81, the highest being £130, and the lowest £52.

† This high figure is due to the large salaries received at once on finishing training in 1914 owing to the demand created by the war.

The figures bring out one point very clearly, viz., that the average salary received after 10 years' hard work and an expensive training is not such as to attract anybody to this profession on purely financial grounds; and that a love of the work and the desire for an open-air life must be the impelling motives. Other figures show the extraordinarily short time most girls seem to stay in their posts; 53 per cent. stayed one year or under; and only 10 per cent. stayed over 5 years. No explanation is given of this.

A very large amount of written evidence has been received from ladies employed as gardeners; it contains many results of experience and much useful criticism, which may well be summarised.

The Drawbacks to the Profession.—The salaries received are low compared with the expense of training, which cannot be much under £100 a year. They only afford a living wage to young, strong women, with no margin out of which to save for illness or old age.

The hours are long, usually 7 a.m. to 6 p.m., with half-an-hour for breakfast and an hour for lunch. There is often stoking and watering to be done.

The holidays are very short; perhaps a fortnight in the year.

There is a difficulty in obtaining posts for very young girls.

The loneliness of the life is very great. Employers are seldom seen, and there are only the other gardeners to talk to.

Causes of Failures.—The following are extracts taken from the evidence received under this heading:—

"Too little responsibility when training."

"Taking posts without due consideration of their suitability."

"Through unwittingly undertaking too much."

"Want of experience in direction of labour before undertaking a reponsible post."

"Not working long enough as under-gardener."

"Too inexperienced when extra work was thrust on me owing to a reduced staff."

"Taking a single-handed place when I had not got the physical strength for it."

"Taking a head post when lacking in tact with men and deficient in organising power."

"Ill health; delicate women should go as companion-gardeners where the hours are more optional."

A woman cannot compete with a man in strength, so that, to be as profitable to her employers, she must make up for it in being more methodical, enterprising and intelligent. She should learn how to do the heavy work so as to know how to

direct it, but should not undertake it herself unless the soil is very light. A woman saves where she does the pruning, sowing of seeds, potting, or undertakes work under glass. The work in stove houses, forcing work, etc., is very trying, and if a woman knows she cannot stand it she had better take a post where there is only the ordinary vinery and greenhouse for beddiug plants and tomatoes. She should remember that a good training is of no use without experience; and that for posts in large places experience should include upkeep, routine work, labour and the general organisation of a large private establishment. The head-gardener is responsible not only for carrying out her employer's orders properly, but for tools, plants, hours of work of the men, and ordinary routine work. She must possess tact and strength, for she is (*a*) working head-gardener, (*b*) overseer, and (*c*) a woman.

Under-Gardeners and Improvers.—Before taking a place as head or single-handed gardener, a woman, even if she has spent one or two years at a training centre, would be well advised to gain wider experience by taking a post as under-gardener or improver, under a good head-gardener.

From the statistics collected it would appear, however, that more than half the women leaving college have gone straight into posts as head or single-handed gardeners.

This undesirable circumstance may be partly due to the fact that posts for women under-gardeners are very limited compared with the higher posts. This scarcity of lower posts is easily explained: employers who keep a small staff naturally prefer to have a man to do the heavy work since he can do such work quicker and better than most women, and for a lower wage. There is also a prejudice amongst men head-gardeners against having women under them; many do not care to give orders to a lady, and feel uncomfortable at having them always about; or it causes discontent among the other men. The housing question is also a difficulty; a man can lodge anywhere and his meals are no trouble, whereas a lady must have special arrangements made for her.

It may be as well at this point to answer the question so often raised: "Can women dig and do the heavier work of the garden?" The answer is "yes"; they do trenching, harrowing mowing and watering as part of their training, and many think nothing of doing this work in their subsequent posts. Whether they should all do so is a different question. The average man would probably accomplish it quicker and better than the average woman, and at a lower cost. The general

opinion is that there is plenty of work to do in a garden which a woman can do as well as, or better than, the average gardener, and that it is uneconomical to give her labourer's work to do, even when she is willing and able to undertake it; in many cases a woman is not strong enough to do a great deal of it.

A compilation of the figures given as wages received by women as under-gardeners shows the following results:—

21	per cent.	received	board and lodging only.
8	,,	,,	under £50.
44	,,	,,	from £50 to £70.
19	,,	,,	,, £70 ,, £80.
8	,,	,,	,, £80 ,, £90.

The highest amount received was £91, and this was a figure received since the outbreak of war; in fact the statistics show that salaries between £80 and £90 are war salaries, and that before August, 1914, no woman under-gardener received over £78. The lowest figure given, apart from those who received board and lodging only, was at Kew, where the salary some years ago was £26, rising to £42; 14 women taken on since the beginning of the war now receive 24*s.* a week, the sub-forewoman receiving 27*s.* They work on the same terms as the men, namely, 6 a.m. to 6 p.m. in summer, with three-quarters of an hour for breakfast and one hour for dinner; the women are now allowed half-an-hour for tea which they make themselves.

As under-gardening can only be looked upon as a continuance of training, women should endeavour to go only to places where there will be a prospect of gaining experience. As posts for women as under-gardeners are limited, a girl who is obliged to earn her living, or some part of it, immediately after training, is, however, often obliged to take any post which offers itself.

Companion-Gardeners.—There are a certain number of women occupying posts as "companion-gardeners." The hours are more optional, and gardening may be supplemented by household duties or secretarial work.

Jobbing Assistants.—Under this heading come those who work for jobbing gardeners; the only instances met with are of women employed by the few ladies who have jobbing businesses. The pay seemed to vary from £1 a week to 6*s.* a day, according to experience.

Teachers of Gardening.—The few big teaching institutions for women in horticulture have a few women on the staff, but mostly employ men-instructors and foremen. Most of the posts for teachers in gardening are at girls' schools and sundry

benevolent institutions, where the lady gardener combines supervision of the garden with teaching the girls or inmates.

The following rates of pay show that this type of work is generally better paid than that of the ordinary head-gardener :—

13 per cent.	received	between	£70 and £80.
22	,,	,,	£80 ,, £90.
30	,,	,,	£90 ,, £100.
35	,,	,,	Over £100.

The highest salary was £150; the lowest £70.

The greater number of these posts are residential. Some full-time non-residential posts were paid £80 to £100. A certain number received salary only, for part-time work; the nature of this and the amounts paid varied considerably. At one girls' school £78 was paid for 3 days a week, at another £28 for 5 or 6 classes a week. A county school for girls paid two guineas a lecture; a teacher for instructing the children at an elementary school received 5*s*. for the first hour and 3*s*. per hour afterwards; another, who taught London children for charitable organisations, received 10*s*. to 12*s*. a week for two days a week during term.

Apart from a knowledge of gardening, there appear to be certain qualifications necessary for the successful teaching of this subject to children and girls; given these, namely, a love of the work, an aptitude for teaching, and great patience and perseverance, the profession is stated to be a most suitable one for women and for which they are better fitted than men. The women are not here entering into competition with men; there is less manual work to do, a man being usually provided for this; it is a less lonely life for women than when they are employed in private gardens.

The general opinion is that more and more girls' schools are developing this side, and that there is a decided opening for properly qualified gardening teachers. At the same time women really suitable for it appear to be few; it is also stated that the training in the teaching side is important and too much neglected at present.

The various openings for women in horticulture have now been indicated. Stress has been laid on the disadvantages from a purely economic point of view in order to discourage those who do not realise the drawbacks. This is only one side of the question, however, and for those who have a real love of gardening and an outdoor life the advantages of horticulture as a profession, as compared with other professions, are very strong. A review of the general prospects in horticulture will be given, together with those in agriculture, in the general summary at the end of this report.

(2) AGRICULTURE.

THE term Agriculture is rightly or wrongly used in this report to embrace, in a general way, those subsidiary branches of the profession which are chiefly taken up by women and which are not technically actual farming. It will be advantageous to make this point clear at the outset, for vague and loose terms used in this connection cause a good deal of confusion in connection with the training of, and the openings for, women in agriculture.

By a "practical training in agriculture," do we mean a training which will enable women to run farms of their own, or take salaried posts as farm hands or farm bailiffs ? Or do we merely mean such training as is necessary for workers in those branches of agriculture which are commonly associated with women's work on farms, and rather loosely included under the heading of agricultural work, viz., dairying and poultry keeping ? As the training and openings in these branches differ in extent and character it is proposed to consider them under the following heads :—A, Farming ; B, Dairy Work ; C, Poultry Work.

The subjects of co-operative farming for women, and agricultural openings for women in the Colonies, will also be briefly alluded to.

A.—Farming.

(*a*) **Training.**—There is no institution for women corresponding to the agricultural colleges for men where a combination of practical and technical instruction can be obtained ; neither are women admitted to the men's colleges. The nearest approach to such an institution is the Horticultural College at Studley, where an agricultural side has been added in recent years.

As regards the theoretical side, however, as taught in the various universities, the lectures are open to women as well as to men. Women have availed themselves of these opportunities in very few cases, and rarely take a degree course. The men attending these lectures have learnt the practical side on a farm, either at their own homes or as pupils. It has not been found easy for a woman to pursue this course unless she is of the farming class, and gets her practical knowledge at home. Either farmers are averse to taking women pupils, or parents do not care to let their young daughters go as pupils on a farm when they would not hesitate to send them to a collegiate institution.

Where, then, can practical instruction be obtained ? When one examines the so-called agricultural training given at

various institutions the following facts are evident: (1) The training resolves itself solely into the teaching of butter and cheese-making, the care of poultry being occasionally added; (2) the agricultural instruction is purely lecture work; (3) the farm attached to the institution is used for demonstration purposes only, and, beyond milking, women take no part in technical operations. There is an indication however, since the outbreak of war, that several of the institutions are realising the need of practical instruction for women. For instance, the Midland Agricultural and Dairy College, at Kingston, Derby, which up till now has provided only systematic courses in dairying and poultry-keeping, has decided (if sufficient entries are obtained) to provide a special course in agriculture which will include instruction in field operations. The fee for a year's course will be £30, board and lodging amounting to another 13*s.* 6*d.* per week.

Studley Horticultural College, and, on a smaller scale, Greenaway Court, Hollingbourne, provide instruction in practical agriculture at the fees given in the Horticultural Training Table.

There are also ladies running farms, some of them on a considerable scale, who take pupils at a cost of from 2 to 2½ guineas per week inclusive. A list of these places with terms, etc., is given in a leaflet on training issued by the Women's Farm and Garden Union.*

(*b*) **Openings in Agriculture.**—If we considered solely what women had done in agriculture as a result of training we should find ourselves practically confined to their work in poultry-keeping and dairying. In horticulture women have set up commercial gardens as an outcome of their training, but as training in agriculture is practically non-existent, we find that the women who are farming, and there were 20,000 of them in the last census, belong, with few exceptions, to the farming class, and have been brought up to the work, or brought into it by marrying farmers. Amongst the more well-to-do their education and mode of life are of the same standard as those of other professional classes. In horticulture no established race of women gardeners of a higher class existed until recent years, and the women who received a training and subsequently set up commercial gardens were pioneers in the movement. It is more difficult, therefore, in collecting statistics and information as to the work of women in agriculture to confine oneself entirely to the experiences

* "Hints on Training for Women in Agriculture and Horticulture," post free, 7½*d.* Women's Farm and Garden Union, Queen Anne's Chambers, Westminster, London, S.W.

of women, who, without the previous knowledge gained in home training, have taken to farming as a profession. The lady farmers come across during the investigation have, in the majority of cases, turned out to be of farming stock, or to have been intimately connected with agriculture all their lives, either as daughters of country clergymen or of small landowners. To consider the question in the light of their experiences would merely end in a discussion as to whether farming pays or not, which in agricultural circles resolves itself into a question of individual capacity, whether of man or woman.

The question it is desired to answer is: What prospect is there for an educated woman, if trained in agricultural work, to earn her living or supplement a small income, whether by running a farm or taking some form of salaried post? The result of the investigations is to show that there do exist a few women who, without previous training (or even knowledge), have taken to farming for the sake of an outdoor life, and who manage to supplement small incomes; no case, however, has been found where an entire living is being earned.

Such women, however, are not sufficient in number to enable one to give definite and reliable statistics as to the possibilities for other women. They have started farming because they had an aptitude and liking for the work, or because they wished to live an outdoor life, and were of the exceptional type who would make a success of anything. All that can be done is to give instances of the most typical cases, to indicate results which have actually been achieved. As the question is being examined from the point of view of a possible profession for women with very small incomes or little available capital, no undertakings will be considered which involve above £1,000 outlay. This excludes all farms above 100 acres. The women who are farming on a larger scale than this have had business capacity, and a good stockman or competent working bailiff to guide them at the start in technical matters; in a few years an intelligent woman learns a good deal in this way, and gains experience as she goes along.

Farming on a small scale is rather different. Unlike the business head of a big concern who is concerned chiefly with administrative duties, a small farmer must do a large proportion of the practical work, and should possess a correspondingly greater capacity for, and a knowledge of, actual technical operations. Moreover, mismanagement, combined with a few bad seasons in succession, could easily cause the loss of the whole capital. Broadly, there are two types of small holdings, according to whether the horticultural

or the agricultural side predominates, and as they often merge one into the other it is proposed, as stated in Part 1, to include under this heading small holdings of a gardening type, kept by persons who have received a horticultural training.

There are, first, the purely agricultural holdings (small farms of from 25 to 100 acres) and, secondly, holdings of from 3 to 20 acres, entirely under garden and fruit cultivation, with the addition of poultry and bees. Between these there range holdings on which several types of work are undertaken; it may be that gardening and fruit growing have been added to an essentially agricultural holding, or that cows and pigs have been added by degrees to what was originally started as a garden enterprise, and a certain amount of the land has been given over to produce food for the live stock.

Small Farms.—Small arable holdings are not very suitable for women; the work is hard enough for a man whose standard of living is lower, and who can do most of the work himself while his wife keeps house. A woman would have to farm on a scale large enough to allow for the employment of a man, and this would involve also relatively more capital than a grass holding of the same size.

On the other hand, there is not much on a grass holding that a woman cannot manage with occasional help. Haymaking and any small amount of arable cultivation can be done by contract. Since the outbreak of war, however, many women who had been in the habit of managing in this way have not been able to get labour for harvest work, though they have found that, once the crops were cut for them, they could do the carting and stacking without help.

Small Mixed Holdings.—It appears to the writer that small mixed holdings of the gardening type are more suitable for two women working together than those that are exclusively agricultural or horticultural. The reasons are as follows:—

(1) The initial capital outlay is relatively less compared with the returns;

(2) It is more possible to increase gradually the area under cultivation and add to the head of stock without much additional outlay in cash;

(3) The risk is not so great where a large amount of capital has not been sunk, as there is less dependence on one class of produce, and a bad season has not such a completely crippling effect;

(4) It is possible to carry on this type of holding in more remote places than is the case with, say, a highly developed type of market garden, and for this reason the land and cost of additional labour are proportionately cheaper.

There are, of course, many pitfalls to be avoided. One holding of this type was barely paying its way after 3 or 4 years

because questions of soil, climate, and nearness to market had not been thoroughly considered beforehand. The soil was too cold and heavy both for successful poultry-rearing and for producing early crops; the farm was in a district where successful local marketing depended on the earliness of the produce; and the distance from railway facilities prevented the profitable use of distant markets. On the other hand, one of the most successful holdings met with was equally remote from markets, with a poor soil, but the soil was easily worked in all seasons, and labour cost less; at the same time it was drier, and, therefore, more suitable for poultry, while a profitable system of purchase by local dealers, and a good carrier service compensated for the distance from markets.

In the following examples, No. 1 is that of a farm on which corn growing is combined with dairying, on a large enough scale to employ a man all the year rouud; No. 2 is a dairy holding combined with a market garden; No. 3 began as a poultry farm and market garden, and has grown by degrees to comprise a little dairy holding as well; No. 4 was started as a market garden, and now includes poultry, pigs, and goats.

(1) Miss G. and her friend have a farm of 65 acres in a corn-growing district of the Eastern Counties. They bought the land and buildings 4 years ago in a very neglected condition, and are slowly getting the land into better order. At the time of a visit they had three fields of autumn-sown wheat, a clover field and 5 pasture fields. Oats had just been sown, a mixture of tares and black oats was then being sown, and one piece of ground was being prepared for roots. The stock consisted of 7 Jersey cows, a Jersey bull, 3 heifers, 4 calves, 3 light horses, 1 pony, 1 heavy cross-bred mare, and a few fowls, but no pigs. They had kept a good number of bees, but these were now suffering from the Isle of Wight disease. The butter is sold to private customers and the corn marketed. The two women work themselves, and employ a man and a girl assistant. Neither of the women had received any special training, and both had come from London. Miss G., however, is very strong, and had a little experience on a home farm before starting farming herself.

They started gradually on capital which came out of the savings of a very small income; this they invested profitably in stock and implements, and increased its value by their own hard work. They consider that, at the present rate of progress, the farm will very soon be supporting them.

(2) Miss W. has a holding of 27 acres two miles from a residential town in a western county. About 4 acres are under ordinary market-garden crops, and the rest under grass in three fields. She keeps 6 cows, a pony, 5 breeding sows and about 60 head of barn-door fowls. She has a retail milk business, and also supplies greengrocers' shops in the neighbouring town. She takes the vegetable produce out herself in a car, and employs a boy to drive the milk cart. Further labour is supplied by a cowman and one old man, and the occasional

employment of a woman. Miss W. considered that if women had business heads and worked themselves there was no reason why they could not make a living, but had a poor opinion of those of whom she had had experience. She had had no particular training, but had been brought up at a country parsonage and had always been used to animals and country life.

(3) Two sisters have a small holding of 9 acres which they started 5 years ago on a capital of £50, their rent and living being provided for them. They invested this £50 entirely in poultry, buying two pens (one of which was of exhibition birds) and the necessary appliances. Out of this they practically built up their present stock of poultry, increasing their hatching each year up to 1,200 chicks. In addition, and entirely out of the proceeds of the initial £50, one goat was purchased and three reared, these having since been replaced by two cows. Butter is made and sold privately in the neighbourhood, and as people are now beginning to come to the sisters for milk, a third cow has recently been acquired. Two bull calves are bought in the market at a few days old to utilise the separated milk, and are kept till 7 or 8 weeks old, when they are marketed and two fresh ones are bought. The chickens are sold to the local poulterers and private customers and the eggs to an egg-collecting depot. Of the 9 acres, 8 are under grass in three fields, one of 4 acres being let off to be acquired when needed for young stock. One acre is under garden cultivation, being planted with apples, plums, cherries and bush fruit. Vegetables are grown rather than flowers as there is a better sale for them locally. The bush fruit is bought by a local jam factory ; surplus vegetables are sent to a shop in the village, and the local grocers take all the tomatoes. The two ladies do practically all the work themselves. They had lived in a town until they started on the holding and, beyond keeping a few hens in a garden for the egg supply of the house, had had no training. One has since taken her first class certificate for butter-making at a county council dairy class, and the other spent three weeks on a poultry farm and has taught herself to milk first the goats and then the cows. What they did not know they have learnt from books and from experience and observation.

They were of opinion that if they had lived in a cottage at a low rent on their present holding, and not in a small, highly-rented house, they might be able to earn their living entirely from their work. The work, however, is very hard, and they did not think many women would stick to it as they had done.

(4) " A " has a holding of 23 acres attached to a small farmhouse. She sub-lets 12 acres, and has about 4 or 5 acres of grass land ; the remainder is cultivated as a market garden and used for poultry runs. She keeps 10 goats, 300 to 400 head of poultry, breeding-sows and pigs, a pony, and 12 hives of bees. Of the garden land about 2 acres have been newly planted with apples, raspberries, and black currants, with potatoes and bulbs between the rows. Potatoes and vegetables are grown on the wired-in patches, which are used in alternate years as fowl runs, and in the original garden of the farmhouse. There is one cold-house and a good many frames. The goats' milk, and the butter made from it, are consumed in the house. Otherwise, except for some private London customers, all the produce is sold retail, chiefly to boarding houses in a neighbouring holiday resort ; for this purpose a van and pony are kept and a lady is employed to drive it ; the same lady has also charge of the goats. The produce sold in this way consists

of vegetables, fruit, jam, cut flowers, eggs, chickens, honey and beeswax. One man is employed regularly to do the heavy work, and, besides the lady who drives the van, two other ladies attend to the poultry and garden with the help of " A " and a friend.

This holding was started 8 years ago by renting the house with 5 acres of land at £30. " A " had £300 capital, out of which she had to live and supply equipment. She went on developing every year, and finding she could not do this and plant fruit satisfactorily under her lease, she finally bought the 23 acres, partly by means of gifts and partly by means of a loan on which she pays interest—sub-letting about half of the land until she is in a position to cultivate it all.

It is interesting to note that, while poultry was the means of building up holding No. 3, " A " is of opinion that poultry is less profitable than the other branches of her work. She considered bees very profitable—until they got the Isle of Wight disease—and last year sold 400 lb. of honey. There was relatively far less work with them for the same amount of profit, than in the other branches.

Another point is that she is in a remote spot 6 miles from a station or town of any size, and that the soil is poor and sandy. In spite of these drawbacks she is able to make the place pay, and, beyond taking in pupils who want light work on account of health, has no other source of income.

As regards previous knowledge " A " had had a short training at two horticultural centres, and had held gardening posts for some years subsequently before starting on her own account; the women she employed had also received previous training.

Salaried Posts in Farming.—Until the outbreak of war posts of this type hardly existed. Investigation has revealed only two women farm-bailiffs, if we exclude a certain number who supervise home farms as a family arrangement. Lady farmers occasionally employ other women to look after stock and help generally. Since the outbreak of war some have obtained posts as cow-women at 18*s.* a week and a cottage, milk and coal. Their duties are to milk the cows, drive the milk cart, feed the cows and calves, and fill up their time doing odd jobs. It is not likely that under normal conditions these women would contemplate taking posts of this nature except for the purpose of gaining experience before setting up for themselves.

B.—Dairy Work.

(*a*) **Training.**—The training of women in dairy work is the only branch of agricultural education which has been systematically carried out on public lines. Most of the county councils provide fixed or travelling courses of instruction either in butter or cheese-making, or in both. Some include teaching in calf-rearing, and the treatment of milk, and most of them comprise lectures on this subject and on the selection and feeding of dairy cattle. Anyone resident in such counties can obtain, either free or at a

Institution.	Cost of Tuition.	Cost of Board and Lodging.	Length of Courses.	Length of Terms.	Housing Arrangements.
University College, Reading.	£24 per session of 3 terms. £30 for 1 year's Certificate course. £16 for 6 months' course £10 for 3 months' course	£32 to £42 per session.	Diploma, 2 years Certificate, 1 year 6 months' course 3 months' course	Session = 3 terms of 10 weeks.	3 hostels for women students.
Lancashire County Council Farm, Hutton.	£10 a term £30 per session 10s. to 15s. a week	12s. 6d. a week.	Junior Dairy course, 9 weeks. Advanced Dairy course, 14 weeks. Diploma Dairy course, 40 weeks.	2 terms of 13 weeks 1 term of 14 weeks.	Live in college.
Midland Agricultural and Dairy College, Kingston, Derby.	15s. to £1 a week £12 for 12 weeks £21 for 24 ,, £27 for 36 ,,	12s. a week.	(1) Short course, 5-6 weeks. (2) Dairy Factory Managers course, not less than 9 months. (3) Dairy Teachers course, not less than 9 months.	Agricultural session = 3 terms of 10 weeks. Courses (2) and (3) = 2 terms, October to December, January to July.	Live in college.
East Anglian Institute of Agriculture, Chelmsford.	£1 a week £10 for 12 weeks 15s. a week for a second 12 weeks, 10s. a week for the rest of the year.	15s. a week.	6 courses of from 4 to 15 weeks.	Open all the year round except 4 weeks in summer, 2 weeks at Christmas, and 2 weeks at Easter.	Dairy hostel.

nominal expense, sufficient teaching in a few weeks to learn the rudiments of dairy work. For those wishing to pursue a longer course there are larger centres where a thorough training in all branches can be obtained at reasonable fees, and for which scholarships are obtainable. The object of these centres is chiefly to improve the knowledge of farmers' daughters in farm domestic economy, and preference is generally given to those who are intimately connected with the farming profession. Other students, however, can also attend at higher fees ; a table is annexed (p. 629) giving the cost to such students of the dairy courses at the principal centres.

Instruction in dairy work can also be obtained at a number of small private places, and it forms an additional subject at some of the horticultural institutions already mentioned.

Length of Training.—Reference to the accompanying table will show that the diploma courses last for from 1 to 2 years ; the short courses of from 4 to 6 weeks only deal with butter-making and the manufacture of cream cheeses ; the short cheese-making courses are from 3 to 9 months in length.

In deciding what length of training is required a girl must consider it in connection with her future career. An intelligent girl can easily learn in a few weeks how to make butter and cream cheeses, and the points connected with the initial handling of the milk and cream for this purpose ; but cheese-making proper is a scientific art which requires much longer training and experience, and the average learner cannot expect to learn much in a two-year course ; a really sound knowledge of the various kinds of cheese made under varying conditions, such as is required for teaching purposes, could not be acquired without many years' further experience. If, therefore, a girl is merely going to take a post as dairy worker in a private establishment where only butter and cream cheeses are made, or wants to know enough to do the same work on a small holding, a few months' training should be ample ; but if it is her intention to teach, or to secure a post as manageress in a factory, or as cheese-maker on a commercial farm, two years' training is essential, and many years' further experience under varying conditions is desirable.

Cost of Training.—The cost of taking the Diploma Course at the county council centres and at University College, Reading, is from £50 to £66 for a session of from 30 to 40 weeks. Tuition, only, varies from 10*s.* to £1 a week, according to the length of the course, and board and lodging comes to from 12*s.* to £1 a week. The details are set out in the table on p. 629.

(*b*) **Openings in Dairy Work.**—For women who have been trained in dairy work, and who do not return to their own homes, the openings in this country are practically confined to salaried posts, as dairy maids, teachers, managers or assistants. A woman with capital who wishes to start an enterprise of her own has the choice of three openings: (1) dairy farming; (2) cheese factories where the milk is bought from neighbouring farms and converted into cheese; and (3) retail dairies. The last-named branch of dairying hardly enters into present considerations, as it concerns distribution rather than production; but one or two successful enterprises were found in which a retail shop in a provincial town was run in connection with a dairy farm and appeared to pay well. Poultry, fruit, vegetables, butter, cream, and soft cheeses were sold as well as milk. There is always a demand in small country towns for first-class dairy produce, and it is these rather than the larger towns in which it is often difficult to get good butter and milk. An enterprise of this kind, however, demands business capacity and organising power, as well as a knowledge of the farming side, while a good deal of capital is involved.

Cheese Factories.—These hardly come within the scope of this enquiry, as they do not involve an outdoor life. There are one or two cases of women running cheese factories successfully after some years of dairy training and experience, and these women are of opinion that the industry can be made to pay. They buy milk from neighbouring farmers and turn it into cheese.

Miss X buys 400 gal. daily for 10 months and employs 3 girl assistants and 1 boy, superintending the business and doing part of the work herself. The farmers take back a percentage of the whey, the remainder being used for pig-feeding, about 20 pigs being kept at the dairy. Her annual turnover amounts to £2,000. The work is hard and continuous, involving Sundays as well as week-days. The dairy closes for 6 to 8 weeks in the winter when the farmers are rearing calves and milk is hard to get.

Small Dairy Holdings.—The writer has not come across many women who have set up for themselves on holdings of an exclusively dairy type. The larger dairy farms, over 100 acres in extent, which do not come within the scope of this enquiry, sent milk up to London or made cheese. Women who worked smaller holdings held the opinion that they could not provide for the wages of a man employed regularly and live on the profit from the holding, but that if they had sufficient experience in farming to enable them to run the holding with occasional assistance it might be possible for them to make a living with the help of women assistants or dairy pupils.

One case visited was that of a lady on a small farm of 22 acres in a southern county, some miles from a town, but in a residential district. The land was all under grass except for ½ acre of potatoes ; rye had been grown on this and cut green for the cows. The stock consisted of 6 cows, calves, 2 ponies, and a few poultry. A man at 15*s*. a week was usually employed, but all the work is now being done by the lady herself, an assistant and a pupil. A milk round has been worked up, and milk is sold at 4*d*. a quart and butter at 1*s*. 6*d*. per lb., while cream and soft cheeses are also sold. The workers deliver the milk personally with the aid of the ponies.

The place was started on a capital of £400, out of which the house had to be furnished, the stock bought and a living provided. The lady had been trained in dairy work only, and had held teaching and private posts before setting up for herself. She did not consider it at all easy to make a living on her type of holding, and thought that with bad seasons, or any strokes of ill luck there was liability to lose all her capital.

Salaried Posts in Dairy Work.—When considering the question of training it was observed that the largest number of women passing through the county council centres of instruction belonged to the farming class. Their after-career, therefore, would not enter into the scope of this enquiry were it not that the posts they take are identical with those open to girls of other professional classes after training. For this reason no distinction has been made between them in collecting statistics as to rates of pay, conditions of living, and numbers of available posts, etc.

The women who take situations after training can be divided into three classes :—

Firstly, and these do not concern us, there are those who go into private households as dairymaids, and who often do domestic work in addition. Their wages vary from £18 to £28 per annum according to age and experience, and they live with the other servants.

Secondly, the better-class farmer's daughter, who, having to "go out," goes to a gentleman's dairy where a cottage is found, or to another good farm where she acts as dairymaid (generally as cheese-maker). In the former case the pay is about 20*s*. to 25*s*. a week, with cottage, coals, milk and butter ; in the latter she lives with the family, receives laundry free, and is paid from £25 to £30 per annum. In some cases where the woman is a particularly good cheese-maker she might get up to £40 per annum.

Thirdly, and it is with this class that we are chiefly concerned, there are the girls of the professional class. In most cases they become teachers ; in order to get the necessary experience, they usually go to a good farm, giving their services in return for the experience, or receiving 4*s*. to 5*s*. per week ; or they obtain a situation as manageress in an institution where

rooms are provided for them, or in a corporation dairy where they would lodge out.

Teaching Posts.—These posts require long experience in practical work of a varied nature; there is much hard work in the early stages, and women must be prepared to turn their hand to anything; they must also have received a sound, though not necessarily an advanced scientific education.

The posts are few, and are hard to secure by the younger women; they are for the most part held at county council centres, some ladies' colleges, and a few private institutions.

The County Council posts appear at first sight to be the best paid, but the actual figures are often misleading, as in many cases the instructress is paid by the week for six to eight months only, and during the rest of the year she must keep herself, as temporary employment is hard to get in the winter months.

From the figures received it would appear that the average salary for instructresses of all kinds amounts to £125. The lowest given was £70 and the highest £200; for assistant instructresses the amount varied from £52 to £140. The work is often hard and the hours are long. The work may begin at 6 a.m., and include Sundays, and there are no half-days off.

Manageresses of Commercial Dairies and Factories.—These posts also require long experience in practical work. In one case the milk of 100 cows was bought daily and turned into Cheddar and Stilton cheeses, butter and cream cheese. The separating and churning were done by electricity; there was a boy to do the rough work and pupils to help. In another case, the manageress of a municipal milk depot had to buy 700 gal. of milk daily and distribute it to hospitals and child-feeding centres, while a large quantity was "reconstructed" for infant feeding. The salaries in this branch varied from £70 to £150, the average being about £90.

C.—Poultry Work.

(*a*) **Training.**—The training in poultry-keeping is at present very inadequate; there is no standardised national examination for diplomas such as the National Dairy Diploma, or the Diploma in Horticulture awarded by the Royal Horticultural Society. Nine only of the county councils have fixed centres where poultry-keeping forms a recognised course, although others may hold lectures and give demonstrations on the subject. Moreover, of these nine, Hutton alone has the stock and equipment on a scale sufficient for those who require a complete course of study.

This subject is also taught at the Horticultural Colleges of Swanley and Studley, and at many of the private gardening institutions given in the table on p. 561. There are also innumerable commercial enterprises in connection with which a small number of pupils are taken, for in this industry, as well as in others, pupils are one of the sources of profit.

There does not appear to be any centre where women can be adequately trained as poultry instructors; this fact is pointed out in the report of the Committee which recently enquired into the Agricultural Education of Women, and the establishment of such a centre, and the institution of a National Poultry Examination with a Diploma, form two of their recommendations.

The length of the courses, and the cost of tuition at the Lancashire Farm School at Hutton, and at the Midland Dairy Institute are given below. For non-contributing counties they are :—

Hutton.

Fees.	*Length of Course.*	*Length of Term.*
Tuition, £10 a term or £30 a session, or 10*s.* to 15*s.* a week.	Junior, 9 weeks .. Advanced, 14 weeks	Session.
	Diploma, 40 weeks	40 weeks.

Board and lodging, 12*s.* 6*d.* a week.

Midland.

Tuition, £1 a week .. Board and lodging, 12*s.* a week	12 weeks, beginning in March.

The fees for students from contributing counties are :—

Hutton.

Board, lodging and tuition, £7 per term, or £21 per session, or 15*s.* to 22*s.* 6*d.* per week.

Midland.

Tuition, 10*s.* per week.

The private poultry schools, and the commercial enterprises which take pupils, charge fees varying with the length of the courses and the accommodation provided.

At one well-known poultry school the terms are 10 guineas for a three-weeks' course, 30 guineas for 12 weeks, and 60 guineas for 24 weeks. Other small schools charge from £5 to £7 a month for tuition, board, and residence.

(*b*) **Openings in Poultry Work.**—*Own Holdings.* — Poultry-farming is an occupation which has attracted amateurs amongst men as well as women, perhaps more than any other outdoor profession, and, possibly as a consequence of this, there are more varied opinions about the openings connected with it than with any other branch of agriculture. Those who have failed to make a living out of it, or who have lost all their

capital, are legion ; this, however, should be no more than a warning to anyone not to take it up lightly without adequate knowledge and experience, and, possibly, the right instinct. There is now and will be an increasing demand for poultry produce of every description. The British are the stock breeders of the world ; and there is an unlimited home market for eggs and a good demand for table birds. Co-operative methods, which are wanted more perhaps in this branch than in any other to enable producers to compete with foreign prices based on co-operation, are slowly making headway. At the present stage of development of the poultry industry it is probably better to keep poultry as an adjunct to other farming operations than to have a poultry farm only. Many women have been met with who have taken up poultry-keeping on ordinary lines on a small scale, with not at all encouraging results. Others, however, have made a success of poultry-keeping on very different lines. It may be of interest to indicate briefly their several methods, if only to illustrate the different ways in which the industry can be approached.

(1) Mrs. B. adopted egg-production on the intensive method, and has been thoroughly successful with it. At the time of a visit she had 350 chickens under 8 weeks old in 8 foster mothers, standing in a yard which measured 7 by 13 yds. On one-twentieth of an acre in the garden there were 9 intensive houses of various patterns, containing about 250 to 300 hens—mostly White Leghorns. From 400 to 500 chickens a year are hatched ; and day-old chickens, eggs and stock birds are sold. The approximate number of eggs sold during the year is 30,000.

Mrs. B. had no previous knowledge of poultry work, and started keeping fowls in the ordinary way in the garden. Owing to the small space and the consequent ill-success of this method she decided to adopt the present system ; and where she formerly kept 24 fowls and had hard work to prevent insanitary conditions, she is now able to keep 400 to 500 birds without the slightest trace of discomfort. She considers that poultry-keeping would be a very remunerative employment for women if conducted on proper lines ; but it requires great care and judgment and thoroughness in details, the lack of which has caused many failures where the intensive method has been carried out without sufficient attention to the main points.

(2) "G." also goes in entirely for egg-production, but adopts quite a different system. She has 57 acres of land, part of a 200-acre farm, her brother farming the remainder as a separate concern. With the exception of two Suffolk mares, kept for breeding purposes, the entire stock consists of poultry, to which the land is devoted, the pasture being used for free range, and the arable for growing the bulk of the poultry food. The food consists chiefly of wheat, but also of barley and peas, most of the soil being unsuitable for oats ; while clover hay, swedes, turnips, mangolds and carrots are also grown.

At the time of a visit in May she had about 1,700 head of poultry ; of these 500 were Buff Orpington hens, mostly 4 or 5 years old, kept for rearing chickens. 300 White Leghorns for breeding purposes, and

over 900 cross-bred White Leghorns in the laying house; she was sending away an average of 800 eggs a day. The cockerels are disposed of at once, and the pullets run with the hens till September, when they are put into their laying quarters—a house 200 ft. by 16 ft., and accommodating 1,000 birds. The incubator house contains ten 200 egg-incubators heated by water pipes on the same system as in a greenhouse, a small petrol stove being used for heating purposes.

The annual net profit for the last four years has been estimated at quite £50 per 200 birds. G. took up farming 10 years ago, and it was on finding that poultry were the most paying stock she had, that she decided some years later to devote the whole of the land to it.

(3) "C.'s" holding is of an entirely different type. She devotes herself almost exclusively to poultry breeding, but includes other branches on a small scale purely for purposes of instructing pupils. She has 28 acres of land, and by a process of sub-letting the grazing of different fields in rotation she is able to get constant change of ground for the poultry and recovers most of the rent which would otherwise be chargeable to them. Also, of the land she keeps in hand one-third is in hay every year, and the hay is sold; the breeding pens are put up in October and go on till March, so that the land is free for hay in April. About 500 stock birds are kept and 1,500 birds are reared annually. A feature of the place is the large room holding 32 incubators, which are kept going from January to May. The employees consist of 1 foreman, 1 boy, and 1 lady; 4 pupils are taken for three-month courses, or for short courses of three weeks. C. set up for herself 20 years ago on half an acre with 20 hens; she had very little capital, and suffered from bad health, and considers that the only training she received on a poultry farm had to be unlearnt before she became successful.

Salaried Posts in Poultry Work.—The salaried posts in connection with poultry-keeping, both for teachers and assistants, are very often combined with dairying; a considerable number of dairy posts now held have been obtained owing to the combined knowledge. It has been found also that many private employers desire to combine gardening with the poultry yard, and at some of the horticultural institutions students are advised to take a short course in poultry-keeping to enable them to undertake these situations. Otherwise the paid posts are chiefly as managers of exhibition farms or assistants to poultry farmers and breeders, who often prefer trained women to men, as they find that an educated woman is more careful and conscientious about details.

The wages offered are from £20, with board and lodging, upwards, the highest being about £40.

Teaching posts are few, but are likely to increase in number as public bodies realise the importance of the industry, and if the recommendations of the Committee on the Agricultural Education of Women are followed up. In Ireland, where the large poultry industry is entirely in the hands of the working women, there is an instructor in every county, and these teaching posts are only offered to women.

At present our county councils chiefly have men instructors and employ women assistants. Where the instruction is given in the form of evening classes, and the districts cover a wide area, there is often much night work on a bicycle, and a man is found more suitable than a woman.

From the opinions obtaining amongst those who have taken up poultry work it would appear that it is specially suitable for women. The hours are long, but the actual physical work is not heavy, although incessant, and one must be strong enough to be out in all weathers. To obtain success it is necessary to be very observant, patient, and attentive to details.

Co-operation for Women Farmers.

It must be pointed out that there are certain drawbacks connected with women taking up outdoor work, which might be largely overcome if some workable form of co-operation could be adopted. These are the loneliness of the life, the tie involved, and the early difficulties in starting in new and untried places without much capital, or knowledge of how best to dispose of produce. Two attempts have been made to deal with the problem of helping women to work profitably on the land, with the aid of co-operative organisation and facilities. They have not, however, been in existence long enough to permit of a proper estimate of the probabilities of success, especially as war broke out just when they weie trying to get a footing, and brought fresh difficulties. The details respecting these two pioneer movements are given below.

Women Co-operative Farmers, Limited.—This company was started in the autumn of 1912 for the purpose of providing a means whereby women trained in agriculture would be enabled to turn their knowledge to practical account by becoming small holders as tenants of the company.

The prospectus describes the general scheme as follows :— "To build up on its land a community of small holders who shall enjoy the utmost independence compatible with membership of the community and at the same time be intimately concerned with the welfare of the company as a whole ; who shall secure for themselves the profits and the increase in capital value derived from the successful working and development of their holdings, and nevertheless have a direct interest in making their relationship to the company profitable to both parties."

The authorised capital is £10,000, the shares being £1 each. £2,000 capital has been issued and £5,000 debentures.

A farm of 223 acres was purchased, and an adjacent one of 160 acres rented, on a high road three miles from Heathfield,

London, Brighton, and South Coast Railway, and 3½ miles from Ticehurst Road, South Eastern and Chatham Railway.

The farm-house and 60 acres are reserved by the company to be developed as a model and experimental farm, and to serve as a training ground for the pupils ; the company are prepared to cut up the rest of the farm into small holdings to suit individual requirements as much as possible. The company intended, if capital were forthcoming, to erect the buildings and lease them with the land. Leases would be practically perpetual subject to a clause allowing the company to terminate the contract (1) for inadequate cultivation, (2) on a resolution by a two-thirds majority of the small holders. The tenant can transfer her lease to anyone approved by the company, and has the option of terminating it after three years. The company has already equipped a few holdings, but, owing to want of capital, has merely leased the land to others who have erected their own buildings.

Eleven small holders have taken up land and are all at work on holdings varying from 1 to 60 acres ; they pay from 30s. to £3 per acre for the land and 8 per cent. on the capital cost of the buildings. Ten pupils are being trained on the company's farm. Machinery and implements can be hired from the company by the tenants, and additional labour is supplied at times ; anyone going on a holiday can have her holding looked after in her absence. There is telephonic connection between each holding and the central farm, and between each holding. In this way perfect independence and freedom of action are obtained, with the possibility of social intercourse, advice as to cultivation, and help in the disposal of produce if this should be required. The produce is sold locally, and in Tunbridge Wells and Eastbourne. The company also owns a milling and bakery business, and has a brick yard and sand quarry on the estate.

Ensbury Growers, Limited.—This company was formed with the idea of meeting two of the difficulties encountered by women after a horticultural or agricultural training.

One difficulty is experienced where women have at once to find posts, in that these posts do not lead to independence, the salaries being such that there is no possibility of saving out of them. The other difficulty affects the woman with capital, whose isolation on land available for small or large holdings tends to the loss of profits of growing owing to the expenses of marketing.

The company proposed, therefore, to acquire land for two purposes : first, to make it available for women with capital

on market-garden leases, with access to co-operative labour, market and living, and to expert advice; secondly, to give employment under a qualified expert to trained women, who as employees would share in the company's profits, and who could rent concurrently small portions of the land on which to grow their own stuff, in their own time, thns laying the foundation of a permanent self-supporting holding.

The company is now in possession of 88 acres of land near Bournemouth, and is prepared to lease land on market garden leases at £5 an acre to women growers; the development of the land by the company itself for the employment and training of women was hindered by the failure of promised support owing to war conditions, but they have recently raised more capital and are giving effect to their object.

Agricultural Work in the Colonies.

Many of the women who have passed through the horticultural colleges, or who have studied dairying or poultry-keeping at the various centres, have learnt the work prior to leaving for the Colonies to be married. A few have gone out to take up the work there independently or to join relations on fruit and poultry farms. It is not possible with the information obtained to deal with the question of the openings and possibilities for women abroad, but attention might be called to two enterprises which have been started with a view to facilitating the openings which exist in other countries.

The Princess Patricia Ranch.—This settlement was started in 1912, under the auspices of the Colonial Intelligence League, to provide a centre in Canada where women who had already received training in Eugland could gain experience in local conditions, and have time to look round before taking up land or work of their own abroad. They were to give their services free for one year in return for board and lodging. The ranch (which is near Vernon, Okanagan Valley, British Columbia) comprises 13 acres. Cows, pigs, and poultry are kept; and vegetables and small fruit are grown besides the crops required for the stock. After a year's work by the first batch of girls the Deputy Minister for Agriculture visited the ranch, and was so struck with the excellent progress that he made a recommendation to the Government of British Columbia that they should take over the ranch as a Government Demonstration Farm, supplying advice, supervision, plant, and stock, while the work would be carried out by the associates of the League as hitherto. His recommendation had just been adopted when war broke out, and the Government reconsidered their decision. For the moment the ranch

is being kept in cultivation by two women, one of whom was a former resident, the League paying the rent, rates and taxes, and the women receiving the profits. It is hoped that after the war the original intentions of the League regarding it can be resumed, and will be the means of attracting women who have received outdoor training to take up this work under the freer conditions which are prevalent in the Colonies.

Women's Farm Settlement in South Africa.—The object of this settlement is "to provide a centre in South Africa where women and girls, with some means of their own, can obtain sound instruction and experience of agriculture and household management under local conditions and train for a life of enterprise and usefulness."

A small farm was leased in 1913 near Potchefstroom in the Transvaal. It consisted of 39 acres, in orchards, lucerne fields, and flower and vegetable gardens. A valuable asset was its proximity to the agricultural college situated on the Government Experimental Farm, where various facilities and privileges were allowed to the students of the Settlement. The enterprise had barely begun when war broke out, and it has had to be temporarily abandoned.

(3)—SUMMARY.

We have now considered what training exists in the various branches of horticulture and agriculture, and have briefly reviewed the prospects for subsequent employment.

In *Horticulture* we have found that until the outbreak of war the salaried posts were limited in number, and that the salaries, although often higher than those accorded to male gardeners of the working class, were low relatively to the expense of training, and did not admit of saving for illness or old age. Of those who have set up on their own account, a very few have struck out along new lines and done well. Putting these aside, practically none is making an entire living without the aid of pupils; those who have started under proper conditions are supplementing small incomes and leading the outdoor life, which they prefer.

What has been said above applies also to *Farming* on a small scale. In normal times there are practically no salaried posts at a living wage for educated women in farming.

In *Dairy and Poultry Work*, while the training can be obtained at less expense, and for the lower posts in less time, the better paid posts are fewer in proportion, and require long experience. Those who wish to set up for themselves would probably find that training in dairy work alone would only enable them

to run some form of retail business or a cheese factory (both of which involve business capacity, and cannot be classed as outdoor work), for dairy farming entails experience in agriculture as well as in dairy work proper. Poultry farming is carried on successfully by many women, but is a very risky occupation for anyone without proper experience.

Apart, however, from the commercial point of view, there are certain advantages in outdoor work to which a money value cannot be attached ; and to many women the important point may be not so much whether gardening or farming pays, but whether an intelligent woman, coming into it from the outside with certain qualifications, and having had sufficient training, can hope to supplement a small income or, alternatively, be able to live after having invested in it the few hundred pounds she possesses. The answer is that quite a number of women are doing this ; they find the work congenial, though hard, and the life healthy. Those who have not invested all their capital in the business, but retain a small private income, are not involved in an actual struggle for bare existence. They have their own homes, and live an independent life ; they get many of the necessaries of life thrown in which in another class on the same income would be regarded as luxuries, such as fresh air, fresh eggs, butter, vegetables, and milk, and possibly a pony to drive, and they can wear old clothes. The life is not monotonous to those who understand it, but full of change with the varying seasons and the different work the seasons bring.

As already observed, a money value cannot be put on these things, but to women who prefer the country to town life, and to whom a rural career, even if attended by a reduction in income, would be preferable to more highly paid but uncongenial work in town lodgings or private situations, the advantages are priceless.

Those, however, who are dependent on social intercourse must realise that they may be largely cut off from this. Also, if they have no liking for the life it is drudgery, for there is very little leisure, and much hard, continuous work ; there is nearly always Sunday work, and week-ending and holidays are only possible when substitutes can be obtained to do the work—and substitutes as often as not involve some mishap.

How far these drawbacks can be overcome by co-operative colonies, where personal independence is at the same time assured, is still a matter of experiment.

It must also be remembered that the answer to the question whether women can make a living on the land depends to

a considerable extent on what is to be regarded as a living. The profit that would keep a man and his wife, the wife doing the housework, would be quite insufficient to keep two educated women, if they are to live with any of the comforts they are accustomed to.

As regards salaried posts the war has caused a large number of employers to adapt conditions of work, in such matters as housing accommodation, provision of meals, etc., to the needs of women. It remains now with the women to make employers realise the difficulties of women workers who are doing work usually done by men of the working class, and the demands which they may reasonably make in view of their somewhat higher standard of life. It is for them also to overcome prejudices on the part of fellow workmen as well as employers. Tact and competence, now that the doors are open, will go far to obviate existing difficulties; while, on the other hand, unreasonableness and incompetence will do the profession an immense amount of harm.

THE GOAT AS A SOURCE OF MILK.

H. S. HOLMES PEGLER,

Secretary, British Goat Society.

Although kid's flesh forms a most acceptable dish, and even the flesh of the mature goat is by no means unpalatable, goats in this country are kept entirely as a source of milk and not in part for meat production as in many districts abroad. The supply of pure, wholesome milk is, needless to say, a matter of national importance, for, in contributing to the health and vigour of the rising generation, it is benefiting the community as a whole. It is to be feared, however, that in many rural districts cottagers living outside the area of delivery by milk carts are only able to procure milk with considerable difficulty, and, indeed, amongst a proportion of labourers' families fresh milk is unobtainable. The reason for this is that in some districts practically all the milk is sold under contract to large distributing firms in the metropolis or other large towns, or to co-operative milk depots, and, when this is the case, little or none is retained for use locally. The result is that even labourers engaged on the farms frequently find it difficult to obtain milk for their families. Even in districts where the milk is not disposed of in this way, it may be made into butter and cheese when only skimmed milk will be obtainable. In both these instances goat-keeping would be especially beneficial.

All the objections which apply to the keeping of a cow by a cottager are met in the case of a goat. The first expenditure for its purchase is within his means; housing accommodation is reduced to a minimum; the food in summer costs very little, and there is no great expense to be borne for the maintenance of the animal in periods when it is unprofitable.

It is for domestic rather than business purposes that the goat is here recommended. Some writers have maintained that there is a fortune to be made out of goat-farming, but under present conditions this is not the case. It would not be wise for anyone, especially if possessed of only a small capital, to embark in any such undertaking in the hope of making a living out of it. The reason is simple. There is no demand on anything like a commercial scale for goats' milk, and though the demand for goats is large and ever-increasing, it is very doubtful if the breeding and rearing of stock for sale would be a profitable venture.

It may be quite possible for individual goat breeders, who have been fortunate in securing the custom of a hospital or private patients in the locality, to make the industry profitable, as the milk may then often be sold at 1s. a quart, but such opportunities are very rare. Any attempt to sell goats' milk on a commercial scale is, moreover, seriously handicapped by the difficulty of maintainiug a continuous supply of milk during the autumn and winter months.

Goats' Milk.—Unfortunately, there has been for many years a widespread belief that goats' milk always possesses a peculiar flavour. It will generally be found on enquiry that people who hold this opinion have based it on their experience as tourists in Switzerland. This flavour may possibly be caused by the consumption of certain herbs, but it is far more probable that it arises from a want of cleanliness in the utensils employed. It is quite certain that the milk from the same Swiss breed in England is not so affected, whilst it is also true that all goats' milk will develop a "goaty" flavour if strict attention is not paid to hygienic conditions.

There are two special qualities possessed by goats' milk which alone should make it popular:—

1. The ease with which it is digested by children, and especially infants.

2. Its almost complete immunity from germs of tuberculosis.

With regard to the first point, the substitution of goats' for cows' milk has been instrumental in saving many young lives. The explanation of this superior digestibility is furnished on

scientific grounds by at least two authorities. The late Dr. Augustus Voelcker held that it was due to the fact that the cream globules were much smaller than in cows' milk, and in a more perfect state of emulsion. The explanation of Dr. Barbellion, a French medical authority, is that the curd of cows' milk forms a dense adhering mass which by agitation separates into clots that are but slightly soluble, but the curd of goats' milk forms very small light flakes, which are soft, very pliable and very soluble, like those in the milk of the ass and in human milk. Samples of these latter as well as goats' milk were submitted to the action of digestive ferments and were found to be digested completely in 20 hours, whilst the same process applied to cows' milk showed only a very slight progress after 60 hours.

So much has been written on the prevalence of tuberculosis amongst cows and the possibility of communicating the disease to the human subject through the milk that, when it is fully recognised how comparatively free from such germs goats' milk has been proved to be, this valuable quality should stimulate its use. In this connection Sir William Broadbent may be quoted. In his address to students on the " Prevention of Consumption and other forms of Tuberculosis," he said: " It is interesting to note that asses and goats do not suffer from tuberculosis, and to bear in mind that the shrewd physicians of past days used to order asses' and goats' milk for persons threatened with consumption."

Goats' Milk for Domestic Use.—To realise the difference between goats' and cows' milk one has only to return to the latter after a course of goats' milk. The difference is very much the same as when skimmed milk is substituted for whole milk. This superiority is not so noticeable when goats' milk is drunk by itself as when it is taken in tea or coffee, or used in milk puddings, custards and blanc-manges ; the rich, creamy taste is then very marked. The taste may possibly be accounted for by some of the reasons given in regard to digestibility. It cannot be entirely ascribed to a higher fat content, because, although in a general way goats' milk contains 2 per cent.—and sometimes 4 per cent.—more butter-fat in its composition than cows' milk, the same distinctive quality of goats' milk is to some extent observable even in cases where the fat content is less than that of cows' milk.

The Yield of Milk.—An average goat will give at its flush 3 pts. a day. A good many give more and a few give less ; but a goat yielding less than 1 qt. at that stage is

hardly worth keeping. This flush of milk should last for at least three months, though the later in the season the goat kids, the greater is the tendency for this period to diminish. Thus, a goat that kids in July will seldom maintain her first yield as long as one that kids in March, whilst, should kidding take place during the rutting season—that is, in October, November and December—the maximum period will be still shorter. The goat which has been giving 3 pts. daily from March to June may be expected to give on the average a quart for the next three months, and if during the subsequent three she gives about 1 pt. a day, the yield may be considered satisfactory. The total milk yield will have amounted to about 67 gal., or 670 lb., which, at the cheap price of 5*d.* a quart, represents a value of £5 11*s.* 8*d.* Better milkers will give 2 qts. for the first three months, and their total yield may be set down at from 80 to 90 gal., whilst the best goats may sometimes yield 3 qts. In exceptional cases even larger yields have been recorded. "Sedgmere Faith," an imported Swiss, milked daily for five days, gave an average yield per day of 10 lb. 5 oz., or over a gal.; this was, moreover, in the month of August after having been in milk for five months. The champion milker, "Leazes Eve" (Fig. 5), yielded during the three weeks ending 18th May, 1912 (having been in profit since 27th April), no less than 242 lb. 13 oz., or over 97 qts. This goat indeed gave nearly half a ton of milk during the first 15 weeks after kidding. Champion "Wigmore Topsy" is another extraordinary milker that has given over 1 gal. a day. The illustration (Fig. 6) shows her excellent udder and well-shaped teats. It should be pointed out, however, that these yields are rare.

Cost of Food compared with Value of Milk.—In estimating the cost of keeping goats to provide milk for home consumption, it is understood that they are fed by a member of the family and that no land is rented especially for them. Rent and wages may, therefore, be neglected. Opinions vary as to the cost of feeding, but it may be said that, with a paddock or good-sized kitchen garden available, the cost of keep during the six months of spring and summer should not exceed 1*s.* a week per goat, or say £1 5*s.* During the remainder of the year, under the "soiling" system, to be explained presently, the goat will consume on an average each day 2 lb. of hay, costing 1*d.*, about ½ lb. of oats and 2 oz. of bran, which may be set down as amounting to another 1*d.* or a total of about £1 10*s.* During the short period that garden produce is not available roots will have to be purchased, and the cost of these would

bring the total for the other six months to, say, £2. This, added to the £1 5s. previously mentioned, makes £3 5s. per annum. Even with an average goat it will be seen that a very fair profit is made. With a superior milker the profit would be considerably greater. The cost of litter—peat moss or straw—and other incidental charges such as service of goat, etc., have not been included, as the value of the manure, no insignificant item, may be set against the former, and the value of kids against the latter. The above is only a rough estimate, and the cost is not based on the prices quoted on the market to-day, but on those prevailing in normal times. On the other hand the costs suggested would be greatly reduced if the extra foods were purchased in fairly considerable quantities.

Habits of the Goat.—The goat is naturally of a roving disposition. It passes rapidly from one form of food to another and rarely stops more than a short time at each, however sweet and attractive it may be. When a goat's fancy can be thus indulged it thrives amazingly, but, unfortunately, its innate delight in mischief—apparently for mischief's sake—renders it necessary to keep it under control. Ordinary fencing is generally useless, for a goat will jump hurdles readily and make its way through the thickest hedge if the least weak spot is to be found. Unless the lines are set very close even barbed wire will not prove an effective bar, should there happen to be any very tempting bait on the other side. Where pasturage is provided, therefore, tethering is necessary. To make this system of feeding successful, frequent change of ground should be possible. Some people endeavour to keep a goat within the narrow limits of a tennis court or a lawn throughout the summer. It is possible that were such a plot reserved entirely for the goat and scarcely ever trodden on by human feet it might provide nourishment for the animal for a certain period, but after a time the soil becomes tainted and the grass practically poisonous to the goat. This result is evidenced by the loss of flesh, anæmic condition, and the other well-known symptoms of a fatal disorder which for want of a better name, has been called "a disease peculiar to goats." As a matter of fact, pasturage is by no means necessary to goats, and, unless they have the range of a big meadow or a park, they will live longer and thrive better, generally speaking, without it.

Tethering.—There are two methods of tethering: (1) by a chain, about 3 or 4 yds. long, attached to an iron pin

driven into the ground, and (2) by using a length of thick, galvanised wire, or, better still as being stronger, one composed of several strands of thin wire twisted together. This wire, which may be 20 yds. or more in length, should be stretched firmly along the surface of the grass and securely pegged down at each end. The goat may then be attached to the wire by means of a short chain, one end of which is fastened to the goat's collar and the other hooked on to the wire by means of a spring hook. The hook moves backwards and forwards with the progress of the goat, which has thus the whole 20 yds. as a length of run. This method of tethering allows the goat greater freedom than is the case when a single tethering pin is used. In both cases, however, it is most essential that the pin be driven close down to the level of the ground, otherwise the chain is liable to get caught on, and wound round, the projecting head, thus restricting the amount of liberty allowed the animal. A cord should never be used for tethering, for when it becomes wet it twists and brings about the same result. The length of the pin will depend on the kind of soil—say, 2 ft. on light soils and 18 in. on heavy land.

It is necessary to warn the goat-keeper not to attempt tethering from the middle of October to the beginning of April. Grass in winter has but little nutritive value, whilst exposure to cold winds and the elements generally without the necessary shelter, or exercise to promote circulation, often causes lung trouble and diarrhœa. It is desirable, also, that the change to grass in the spring should be gradual, or the fresh herbage is certain to cause bad attacks of scour, which, if neglected, may have a fatal termination.

Housing and the "Soiling" System.—During the autumn and winter months goats are best kept on the "Soiling System," that is, the animals are housed and all their food is brought to them. Where a considerable number are kept it is advisable to erect a special goat-house, or to adapt some existing building for the purpose. A simple form of house is a loose box or out-house, bedded down with peat-moss litter. Feeding receptacles, preferably small galvanised pails, may be arranged on one side, a hay-rack on another side, and a long bench about 2 ft. wide and the same height from the ground on a third side. This bench serves as a sleeping as well as a milking bench. Goats prefer a hard bed, and especially one that is raised above the level of the floor. The objections to the loose box are that when the inmates are strangers to one another they are apt to

fight, and when one acts the bully she prevents her companions from getting their share of food. In the former case the goats will probably fraternise as they get accustomed to one another, but in the latter the troublesome animal should either be removed or fastened to a ring in the wall. An alternative plan to the loose box is to erect miniature stalls. Space does not admit of details for the construction of such stalls, but these may readily be obtained by consulting one of the books on goat-keeping. Stalls occupy less space, but give more trouble, as they require cleaning out daily to keep them sweet; further, unless the stall is quite narrow—2½ ft. in width at the most—and the stall chain quite short and fastened to the centre in front and not at either side, the goat is likely to turn round, in which case the droppings fall into the feeding pail and get mixed with the food.

Points in Feeding Goats.—The goat-keeper must bear in mind three important points in feeding his stock. The first and most important consideration is absolute cleanliness, both in the food itself and in the receptacle for it. The best form of receptacle is a metal pail; wooden mangers are objectionable as they get gnawed away and are more difficult to keep sweet. The second point is that variety of food is essential; no animal tires so quickly of the same food as the goat, and it will soon give up eating if a change is not provided. The third point is one of economy. If a goat is fed carelessly, without due regard to its tastes or capacity, it may cost as much as its return in milk is worth; thus hay may be wasted to any amount if thrown on the ground or if placed in the hay-rack in needlessly large quantities. In order that this fodder may not be too readily pulled out and only tit-bits consumed, it is necessary that the bars of the hay-rack should be not more than 1½ in. apart. A still more economical plan when hay is scarce and dear is to give it only in the form of chaff mixed with oats and bran. Oats again will be wasted if mixed with the residue of the previous meal. Bran is best given by itself, either dry or still better as a mash. It may be added to chopped roots or potatoes, but never to corn, since to obtain the corn more readily goats will often blow away the bran. Middlings or sharps may be given instead of bran for a change with chopped vegetables.

From their kid stage goats should be encouraged to eat all vegetable waste from the kitchen, or household scraps, such as broken bread, bits of toast, boiled potatoes, oatmeal porridge,

etc. In the garden there is scarcely any plant which is not acceptable. The greatest care should be taken, however, to prevent goats from eating such more or less poisonous shrubs as rhododendrons, yew, privet, and laurels. When the supply of garden produce fails, swedes or mangolds should be purchased if they can be obtained at reasonable prices. To save trouble to the attendant, and also to keep the goat occupied, these roots are best given whole, after careful washing, but they may be chopped into "fingers" as for sheep. In the former case the goat will scoop out the flesh, leaving the outside skin as a shell.

In summer, grass may be cut and supplied instead of hay; this is the most economical way of utilising it. People who live in the heart of the country can take a goat along the lanes for a walk like a dog, allowing it to nibble at the roadside as it goes along.

How to start Goat-keeping.—One of the greatest difficulties which beset the prospective goat-keeper is to obtain suitable stock. The best specimens of goats are frequently sent to the Colonies and the United States of America, and as no fresh stock can be imported from abroad to replace them, it is necessary to depend entirely on home-bred animals. There is still available a fair number of common goats, but many beginners are too ambitious and wish to start straight away with expensive pedigree goats. It is much better to begin with the common goat costing up to £2 or £3, and to improve the stock later. This may be accomplished in the following manner: Well-bred kids of good pedigree may often be obtained comparatively cheaply by previous arrangement with the owners of well-known strains. The purchaser should endeavour to procure only Herd Book stock with, if possible, "milking blood" on the side of both the sire and dam, but at least on one side. When the common goat has a kid or kids, these should be destroyed at birth and the unweaned kid of superior pedigree should be fostered upon it; this may be easily done if the kid is under a fortnight old. The cost of the pedigree kid may be 15*s*. or even a guinea, but the money will be well spent, as the stud fee would probably have amounted to as much.

Herd Book stock should not be confused with animals that are merely entered in the Kid Register. Novices in goat-keeping are unfortunately often deceived by the statement that a goat is "registered." This word is frequently used to give the impression that the animal is entered in the Herd Book, but though most of the entries in this volume appear also in the

Kid Register only a few of those in the latter will be found in the Herd Book. The Kid Register, it should be explained, is in no sense a record of pedigree but merely a guarantee of age, and is intended chiefly as a qualification in that respect for competition in kid or goatling classes. Every goat that is entered in the Herd Book is given a number, and that number is supplied on the certificate card issued by the Herd Book Editor of the British Goat Society.

In selecting a goat it is well to remember that there are certain features which may be regarded as characteristics of milk production. The body should be long and fairly deep, although if the latter point is very marked it is probable that the animal is aged. The ribs must be well sprung—this is important—whilst a long head and a slender neck are generally considered to indicate a good milker. If the goat is dry the quality of the udder cannot be ascertained, but if in profit the udder should be carefully examined. It should not only be of good size but soft and pliable, and the teats should be long and pointed, as they are then most easily handled. It is always desirable for the purchaser to see the goat he is about to buy milked at least once before parting with his money. This is necessary not merely to ascertain the actual yield but to find out if the animal stands quietly to be milked, as a good milking goat is often parted with on account of the trouble she gives the owner in drawing the milk from her. A goat purchased in profit should not be less than two years old or over five. The age can be detected by examining the teeth, for particulars of which the reader should refer to the various books on the subject.

The Breeds of Goats.—In this country there are at most five breeds of goats, two of which belong to what may be called the common kind, and the other three to the improved varieties. The first are the English and the Irish goats, the former being short-haired, with horns rather small and branching outwards, and the latter long-haired with more upright horns. Both are prick-eared and, with slight differences, resemble the common goat in other parts of Europe. The superior breeds in their order of value as milkers are the Toggenburg of Swiss origin, the only strictly pure breed we possess, and the Anglo-Nubian, a variety now regarded as a separate breed but produced many years ago by crossing the English goat with imported stock from the East. A separate section in the Herd Book is devoted to this variety and another to the Toggenburg.

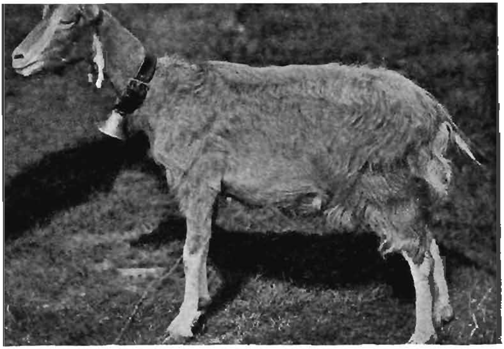


FIG. 1.—A Toggenburg from the Toggenburg Valley, Canton St. Gall, Switzerland.

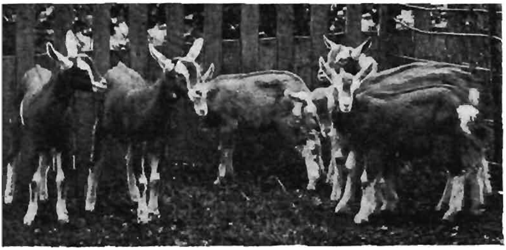
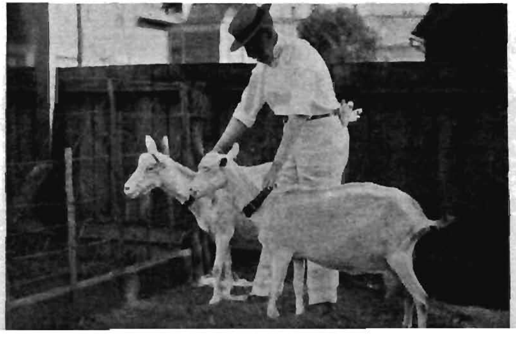


FIG. 2.—Group of Toggenburg Kids.



As regards the Toggenburg, a description is advisable to enable anyone not an expert to recognise a true specimen. This is the more necessary, as, in consequence of its comparative rarity in this country and the high prices it commands, goats of inferior breeds are frequently sold to the uninitiated. The chief peculiarity consists in the colour, which is invariably a light drab, though when the hair is long it approaches somewhat to sandy. This colour is relieved by white markings which are shown on the head by a white streak down each side of the face, a white muzzle, and ears having more or less the same absence of colour. White is also present under the tail, on each side of the rump, on the limbs from the knee and hocks downwards, and very frequently under the belly. The accompanying illustrations (Fig. 1 and Fig. 2) show most of these markings and also two tassel-like appendages which are almost invariably present, though not restricted to this breed. Horns are often seen on the Toggenburgs in England, though in Switzerland they are rarely met with, the breed being there regarded as hornless. The Saanen, also known as the Appenzell, another Swiss breed, is like the Toggenburg in form, but is entirely white. Fig. 3 gives a good illustration of this variety.

In addition to these breeds, there are what are known as "Swiss" and "Anglo-Swiss," the former being a cross between the Toggenburg and other Swiss breeds, and the latter a cross again of these with the common goat or the Anglo-Nubian. Probably this last cross represents the best all-round goat we possess, as it combines the heavy yield of the Swiss, be it Toggenburg or Saanen, with the superior quality as regards butter-fat, of the Anglo-Nubian. A good specimen of this cross is shown in Fig. 4, whilst Fig. 5 illustrates a similar combination, but with the Saanen in place of the Toggenburg, the Swiss here predominating over the Eastern blood. To the average goat-keeper who wants a milker and cannot afford a high price the matter of breed need not be greatly considered. Nearly all the best milkers of the present day are cross-bred animals, the result of careful selection from known milking strains. A careful study of the Herd Book, which is issued in parts, will reveal the strains in which the milking feature predominates, as each part contains what is called the "Star Section" restricted to winners of milking prizes. Goats in this section have one or more asterisks affixed to their names to indicate this attribute. The student of goat-breeding is, therefore, recommended in making his selection to trust more to the strain than to the breed in starting a herd of milkers.

Breeding.—The pairing season for goats is from September to January, but the sooner the service can be arranged the better, as it is desirable that the female should have her kids in February or March, so that the young ones may have all the spring and summer before them. The period of gestation is about 21 weeks, or roughly five months. She-goats that have not been served previously will come into season during January and even, though less frequently, in February, but after that month oestrum will occur only very exceptionally until the following September. People who keep three goats—and this number is necessary to provide an average family with milk during the greater part of the year—should endeavour to arrange for the service of one in September or early in October, the second in November or December, and the third, if possible, in February.

Signs of oestrum in the female are in some cases very transient, especially in the late spring and summer. These signs consist in frequent bleating, a constant shaking of the tail, a turgid condition of the vulva, loss of appetite, and restlessness, and if the goat is in milk a temporary diminution in the milk yield. This condition will last from one to three days.

It is essential, if the owner is endeavouring to improve his stock for milk production, to secure the services of a male bred from a good milker, or, still better, having "milking blood" on both sides of his parentage. The kids will then be worth rearing; otherwise it is far better to kill them at birth and to use all the milk from the goat for domestic purposes. It seldom pays to rear male kids, and it is usually less expensive to pay even a guinea fee for the services of a good male than to rear and keep a stud goat, as the odour and objectionable habits of these animals render them anything but desirable pets.

A she-goat that has given birth to kids generally recovers without much difficulty. If it is decided to rear the young ones they may be left with the dam for six or eight weeks and then weaned, but if the value of the milk consumed during this period is reckoned, the kids will be found in most cases to have cost more than they are worth.

Milking and Care of Milk.—For the first three or four days after kidding the milk is specially adapted to the young kids and is not suitable for human consumption. After that time, however, the goat can be milked at least twice daily, or three times if the yield amounts to something like a quart on each occasion.

'IG. 4.—An Anglo-Nubian-Toggenburg, showing development of udder.

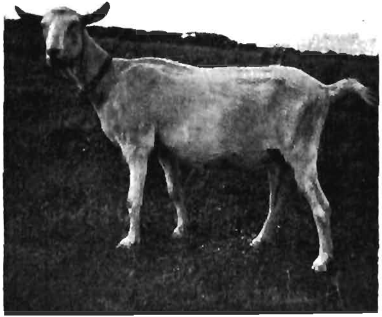


FIG. 5.—"Leazes Eve," Anglo-Nubian-Saanen. A Champion Milking Goat

FIG. 6.—"Wigmore Topsy." A Gallon Milker.

Milking consists in sliding the first finger and thumb along the teat and squeezing out the milk. It is an operation easily learnt, but requires some practice before the requisite facility can be acquired. In regard to milking two points should be emphasised. Milking should be carried out at regular intervals and the udder completely emptied each time. The more quickly the milking is performed the better, for if lingered over the goat gets fidgety and impatient and is very apt to place a hoof in the pail or pan, or to upset the receptacle. An impatient animal should therefore be carefully watched towards the end of the operation, and any such movement prevented as far as possible. It is a good plan in such cases for the operator to have an empty jug placed beside him, in which to pour the milk as the process goes on. The last drops, or "strippings," are always the richest.

All utensils must be kept scrupulously clean by scalding with boiling water and exposure for a time to the air, so as to avoid all odour of stale milk. As milk is easily contaminated, it should not be brought into contact with any strong-smelling substance. When the milk is brought from the goat-house, it should be drained through a clean butter-cloth, placed over a perforated basin, into the pan intended for its reception. It should then be stored in a cool place—a dairy for preference—till required for use.

SUGGESTIONS FOR SAVING LABOUR.

THE necessity for economising labour, already pressing, is likely to become more insistent in the near future. Farmers, therefore, should carefully consider whether modifications of some of the usual farming methods might not help them to tide over a difficult situation.

In cases where wheat is taken after potatoes, and the land is clean and friable, ploughing may be omitted, and the seed sown broadcast and cultivated in. Similarly, adopting a common northern practice, broadcasting might take the place of drilling on grass land turned over in crested, well-packed furrows. After mangolds, too, on free-working land devoid of weeds, the seed may be drilled or sown broadcast, and immediately ploughed under lightly with a double-furrow plough. These are suggested as typical examples of cases in which both time and labour may be saved. As against the saving of labour it should, however, be pointed out that broadcast sowing requires about one-fourth more seed than drilling.

Where hand-hoeing of corn crops is practised, the distance between the rows, usually from 6 in. to 7½ in., might be increased to 8 in. or 9 in., to permit of easy horse-hoeing.

In general, however, where horse-hoeing cannot be practised, the wetter the climate, or the more the land is subject to the growth of annual weeds, the closer the drill coulters should be set. When weeds are plentiful it is advisable, immediately after harvest, to disc or lightly scarify the surface of the land, to encourage the germination of annual weeds, which should afterwards be ploughed in.

Under the Norfolk four-course rotation the area devoted to roots imposes a severe strain on labour, even in normal times. At present all indications point to the necessity for modifying the usual practice. It is well known that success in root-growing, and the welfare of the crops that follow, depend largely on careful, thorough, and persistent cultivation of the root "break." Anything short of this endangers the supply of winter keep for stock and encourages weeds. It is desirable, therefore, that farmers should adopt every practicable means of suppressing weeds at all stages of the rotation, *e.g.*, by the growth of heavy corn crops, and the inclusion in the root area of such crops as will suppress weeds, save labour, and provide keep for stock in winter.

The following examples are intended to indicate the lines upon which the cropping of the root "break" might be arranged. It must be clearly understood, however, that the crops selected, and the area devoted to each, will vary with the soil, the climate, and the nature of the live stock kept.

1. *Vetch Mixture, Marrow-stem Kale, Mangolds.*—*Vetches* are one of the best "smother" crops in cultivation; they form an excellent preparation for succeeding crops, and they are easily grown. For forage purposes they should be sown in autumn with an admixture of cereals and a few beans. The cereals and beans will provide support for the vetches and facilitate cutting. For soiling or ensilage, it is usual to drill from 2 bush. to 3 bush. of winter vetches per acre, along with 1 bush. to 1½ bush. of winter wheat, rye, or oats or a mixture of these, and about ½ bush. of beans. When required for hay the proportion of vetches should be reduced, as an additional precaution against lodging and to enable the crop to be stacked quickly. A useful mixture for a vetch hay crop intended to provide fodder for cattle or sheep would be 70 lb. of winter vetches, and 2 bush. to 2½ bush. of winter

oats per acre. Beans should be omitted when hay is the object. The right time to cut is when the small seeds in the pods at the base of the plant are about half formed. If left too long the crop becomes fibrous and stock refuse it ; on the other hand, if cut too young the vetches will wilt and fall to dust. The method of cutting and saving the vetch mixture is precisely the same as in the case of "seeds" hay, except that it is desirable to sweat the crop in the stack a little more. The crop should be ready for cutting about the middle of June, a time of year when the rainfall is usually low and the sunshine abundant. No great difficulty, therefore, need be anticipated in making it into hay. In wet seasons or in a damp climate, it should be made into silage. After the removal of the vetch crop the ground may be ploughed or cultivated and left uncropped until sown with wheat in autumn, or it may be disced or scarified and sown with an autumn catch crop such as white mustard, rape, or soft turnips (unsingled) for sheep folding.

Marrow-stem Kale resembles Kohl-rabi, but possesses a longer and thinner stem, and is topped with a bunch of green foliage similar to that of Thousand-headed Kale. Stock readily eat both stems and leaves, and the crop may be soiled or fed on the land from late autumn up to Christmas. After that time the stem gradually becomes more fibrous and less palatable. It is one of the best drought-resisting crops grown in this country, and is usually sown in the same way as turnips from the middle of April till the end of June.

It may also be sown like rape and thinned, if necessary, by cross-harrowing, or other mechanical means.

As regards *Mangolds* it need only be stated that, to relieve pressure of work in spring and ensure quick germination and early growth, the land may be dunged, and, if clean, ridged up in autumn, and the winter tilth and moisture preserved, as far as possible.

2. *Vetch Mixture, Thousand-headed Kale, Mangolds.*—This arrangement is suited to a wider range of conditions than the first example, by reason of the fact that Thousand-headed Kale may be allowed to stand over the winter.

Vetches and Mangolds.—See foregoing notes.

Thousand-headed Kale, when drilled in July or August, well manured and afterwards singled, under favourable conditions will supply a valuable and very bulky food for both sheep and cows in early spring from March onwards.

When sown in March, April, and May the crop will be ready for use in October, November, and December.

Thousand-headed Kale has taken the place of rape in many districts, as it yields a heavier crop. It reaches its maximum development on good land after being singled, but in the ordinary course, when the crop is grown for autumn use, or on the poorer classes of soil, it is probably better left unsingled. If not too closely grazed it will produce a second crop after folding. It affords excellent food and shelter for ewes and lambs in early spring. It is extremely hardy, and is capable of resisting both frost and drought.

The seed is drilled at the rate of 4 lb. to 6 lb. per acre, or sown broadcast at the rate of 10 lb. per acre. The crop transplants well.

3. *Vetch Mixture, Swedes, Mangolds.*—This arrangement is suited to a damp climate, and may be preferred by those who are accustomed to rely largely on swedes for the winter feeding of sheep. In the warmer southern counties, Kohl-rabi may be substituted for swedes.

Vetch Mixture.—It may be desirable to convert the vetch mixture into silage, in which case the area under roots may be reduced to a minimum. (See Leaflet No. 9, *Ensilage*).

Swedes.—The same remarks apply as to *Mangolds* above.

The examples given above will not meet all cases, and other crops may have to be included for feeding in late autumn, (cabbage, rape, or maize) and in late spring (rye). Further particulars as to supplementary forage crops will be found in Special Leaflet No. 28 (*Suggestions for the Cultivation of Catch Crops and Home-grown Feeding Stuffs*). The fewer the crops, however, and the better the distribution of labour throughout the year, the less will undue pressure be felt at any particular season.

It will be noted that the essential difference between normal practice and the cropping suggested in the examples given, lies in the introduction of a vetch mixture as a partial substitute for roots. Numerous experiments conducted throughout the country have clearly indicated that in England the feeding of unlimited quantities of roots, or even quantities much in excess of ¾ cwt. per head per day, to full grown cattle is distinctly wasteful. It has further been shown that a very moderate allowance of roots, say, half of the quantity stated above, supplemented by other foods, such as chopped fodder, treacle, cake, and meal, will suffice at relatively little expense to fatten most cattle. Similarly, less than the usual quantities

of roots might often be given with advantage to young cattle and dairy cows. Several farmers in East Anglia have already curtailed their root area, and depend entirely upon silage, made from a vetch mixture, to supply the succulent portion of the winter rations of milch cows and young, growing cattle.

Well-made vetch hay is admirably adapted for feeding along with foods rich in carbohydrates, such as roots, straw, and the starchy cereal grains and offals. It might also be used partly to replace the more expensive albuminous cakes and feeding stuffs.

In an experiment* conducted recently on the farm of Sir Horace Plunkett, in County Dublin, it was found that for winter milk production a daily ration consisting of—

14 lb. Oat and Vetch Hay,
14 ,, Meadow Hay, and
70 ,, to 84 lb. Rape or Hardy Greens,

proved quite as useful as :—

21 lb. Meadow Hay,
56 ,, Roots,
3 ,, Maize Meal, and
7 ,, Decorticated Cotton Cake.

It was estimated that the cost of the former ration was approximately half that of the latter.

The vetch mixture will yield, on the average, about 14 tons per acre of green forage or an equivalent in dry matter of about 20 tons of mangolds. The ratio of green weight to dry (hay) weight will vary according to the conditions under which the forage is grown and the state of the weather during haymaking, but it will be safe to assume that 14 tons of vetch forage will yield, generally, about 3 to 3½ tons of hay per acre. Made into silage in a modern stave or concrete silo the shrinkage will probably be about 10 per cent. In a stack silo it may be much higher unless great care is taken in the making. The fact that vetch hay or vetch silage has to be made about the same time as ordinary hay will not permit of much leisure at that particular season of the year, but it should not be forgotten that silage may be made during damp or showery weather, and that, as regards hay-making, machinery has rendered the farmer to a large extent independent of manual labour. On the other hand, the labour of feeding hay or silage is insignificant as compared with that incurred by feeding roots.

* See articles on "Continuous Cropping," by T. Wibberley, in this *Journal* for November and December, 1914.

LAYING COMPETITION AT BURNLEY.

EDWARD BROWN.

FOR nine years the Northern Utility Poultry Society, which is largely composed of artisans in a great manufacturing centre, has conducted laying competitions. The earlier of these were for 16 weeks. The competition described in this article extended over a period of 12 months, from 15th October, 1913, to 4th October, 1914, the report of which has been issued by the Society.

In no part of the United Kingdom has the keeping of poultry for egg production, as a supplementary pursuit, been developed during recent years to a greater extent than around Burnley. The development has necessarily been more or less intensive in its nature owing to local conditions, among which must be mentioned the high cost of land for allotments, and also to the realisation of the fact that the poultry plants should be conveniently situated so that the stock can receive that regular attention which, especially under these conditions, they require for the attainment of success.

A further point to be noted is that the local demand for eggs is large, and prices are always extremely good. It is evident that, with the increased cost of production, due to the more complete equipment required, to the labour involved, and to the fact that all food must be provided, the average productiveness of the hens is of supreme importance. A rate of laying that would be profitable upon an ordinary farm, where poultry are included in the general stock, and find a considerable part of their food supply, would be inadequate when the fowls are kept in yards with very limited range. Without increase of fecundity, therefore, the margin of profit would be insufficient.

In view of the desirability of encouraging egg production in industrial areas, the Burnley example is of considerable value, and these laying competitions have exerted a wide influence.

For the purpose of the competition of 1913-14 the Society rented from the Burnley Corporation a small holding, three acres in extent, upon which was a house for the manager. The rent and rates for the year amounted to £42 13*s.* 7*d.*, which appears to represent an average price for the district. Upon this site poultry houses and runs were erected; the cost of the plant was £360, which was met from the reserve funds of the Society. The number of members is 220.

The competition was arranged in four sections, namely:—

(1) *Small House Section.*—The ordinary small house was used in this section: 12 ft. by 8 ft. and 5 ft. 6 in. high at the eaves, rising to 8 ft. at the centre, with a run allowing 10 sq. yds. for each bird.

(2) *Semi-Intensive Section.*—A large flock was located in a house measuring 36 ft. by 15 ft. and 7 ft. high at the eaves, rising to 11 ft. in the centre, and allowing $3\frac{1}{2}$ sq. ft. of floor space for each bird. Outside was a run, divided into four sections for alternate use.

(3) *Local Section:* restricted to competitors within a radius of eight miles of Burnley, the houses used being similar to those in No. 1.

(4) *Dry Feeding Test:* in which were birds representing four noted laying strains.

Hitherto, in competitions held at Burnley and elsewhere, it has been customary for each lot of four or six birds to be separately housed. However necessary that arrangement may have been for the purposes of a competition, it could not be regarded as economic, either in respect of cost of equipment or of labour. As an example of the expense involved under the former head the Harper Adams Laying Competition may be cited; the capital expenditure for houses and runs was equal to £1 10*s.* 8*d.* per hen, and the annual charge for depreciation at 15 per cent., which is not excessive when the short life of wire netting is kept in view, was no less than 4*s.* 7*d.* per hen, or nearly two-thirds the food cost for the year. Such expenditure may be justified where sale of breeding stock is the main object, but can never be satisfactory for market egg production.

The Burnley competition is therefore of special interest in that, for the Small House Section, an arrangement has been adopted which more nearly approximates to the economic standard. Each of the houses used accommodated 24 birds, divided, however, by a latticed partition into two lots of 12 each. Perhaps this may have been desirable for special reasons, but in general operations it would not be necessary. On the other hand, the whole 156 birds in Section 2 were placed in the semi-intensive house, here again grouped in two lots, heavy and light breeds respectively.

As each competitor in the open sections was required to enter eight birds, four in the Small House Section, and four in the Semi-Intensive Section, comparisons between the two can be made, as each group can be regarded as equal, and feeding during the test was the same in both cases, together with scratching opportunity and space in open runs; the only differences to be noted are as regards the size of house and the number of inmates. For the reason that the Local Section was restricted to small houses the same comparisons cannot be made.

The Dry Feeding Test did not prove successful. For that purpose 16 birds were lent and housed together. The feeding consisted of equal parts of bran, biscuit meal, scraps, ground oats, and biscuit dust, with 10 per cent. of fish meal as a dry mash, and of equal parts of wheat, oats, cockle and kibbled maize, or broken barley mixed and given in an automatic feeder. The report states that "the birds never seemed to have the same bloom and vigour as the others, particularly during the winter months, and the manager had the greatest difficulty in keeping them in anything like a good hard condition." This does not confirm other experience, but the system may be more suited to birds with greater range.

In the figures given as to the results obtained, it is desirable to keep in view the fact that the number of birds of the respective breeds is very uneven. This fact may have considerable influence upon the place secured in the competition by any given breed. Without absolute uniformity of number of hens in each breed, absolute comparisons cannot be made. This does not, however, invalidate such comparisons as are made between the large and small houses. The following table shows the differences as to average number of eggs per hen and the money values:—

Average Eggs Laid and Values per Bird.

Breed.	No. of Pullets.	No. of Eggs.		Average Values.		Values, increases of.	
		Large House.	Small House.	Large House.	Small House.	Large House.	Small House.
				s. d.	s. d.	s. d.	s. d.
White Wyandottes ..	48	174·62	192·35	16 10¾	18 6½	—	1 7¾
Buff Orpingtons	16	136·75	142·31	13 0	14 5½	—	1 5½
Buff Rocks ..	4	140·25	163·25	12 10	15 10¾	—	3 0¾
Rhode Island Reds ..	4	181·00	167·75	17 8½	17 2	0 6½	—
White Leghorns	68	166·30	166·94	15 10¾	16 2	—	0 3¼
Anconas ..	16	181·81	173·06	17 3½	17 1	0 2½	—
All Breeds ..	156	167·13	172·98	16 0	16 10	—	0 10
Heavy Breeds	72	164·65	178·25	15 10	17 5	—	1 7
Light Breeds	84	169·23	168·10	16 2	16 4	—	0 2

Whilst the differences are small in the aggregate (save in the possibly exceptional case of Buff Rocks), it is evident that the smaller flocks yielded a larger number of eggs in winter.

This is more apparent with heavy than light breeds, save in one case. So far as this test is concerned, therefore, there is no important advantage of one system over the other in some of the breeds, but in others the smaller house of 24 birds, more especially with heavy-bodied breeds, yielded the better result. That is the chief lesson of this competition. How far this is compensated for by greater cost of equipment and of labour requires further proof. One point should not be forgotten, namely, that the birds in competitions of this character are carefully selected and may be assumed to be bred from stock known to be highly fecund.

One of the most important problems presenting itself to poultry-keepers is the securing of a regular supply of eggs, and in this connection the figures afforded by this competition are interesting. Below are given the actual number of eggs laid per month and also the index numbers, taking the maximum month (March) as 100:—

Months.	*No. of Eggs per month.*	*Index Nos.*
October (1913-1914)	2,267	23·42
November	2,277	23·52
December	5,170	53·41
January	3,812	39·38
February	5,674	58·61
March	9,680	100·00
April	8,632	89·17
May	7,897	81·58
June	8,824	91·15
July	6,345	65·54
August	5,462	56·42
September	5,669	58·56

Of the 71,709 eggs produced during the twelve months, 13,526 (or 18·86 per cent.) were laid in the winter cycle, that is, October, November, December and January, this percentage being distinctly above the average.

The cost of food under such conditions must always be heavy. In this competition it worked out at 7*s.* 4*d.* per bird, though by October last feeding stuffs had not risen seriously. The value of eggs sold per bird was 19*s.* 3*d.*, and the average price was 1*s.* 4½*d.* per dozen. No commercial poultry-keeper could hope to attain such a price save, perhaps, in such a district as Burnley. The rise in the price of eggs from early August doubtless contributed to this result, as nearly 13,000 were disposed of from 1st August to 14th October.

The ground occupied for this competition was fresh. A question arises as to how many years the soil can be stocked at the rate of 140 birds to the acre without becoming contaminated—a question of some difficulty where stock is kept and chickens

raised on the same ground. In this direction laying competitions generally afford no guidance, but some data may be available if the Burnley ground is occupied continuously for four or five years.

Of the 424 birds entered, 27 died, or 6·4 per cent. Counting the hens at *7s. 6d.* each, these deaths on a commercial plant would have involved a loss of £10 *2s. 6d.* Any increase in these losses, in addition to depreciation in the value of stock, would become a serious annual charge.

The balance sheet of the competition shows a profit balance of £131 *11s. 1½d.* Entrance fees account for £94, and the prizes for £21 *2s.* Considering that wages amounted to £88 *15s. 2d.*, it is evident that this competition offers encouragement to poultry-keeping on these lines if continuity can be attained.

HUSK OR HOOSE IN CALVES.

HUSK or hoose is a parasitic disease of calves caused by the presence of small thread-like worms in the tubes of the lungs.

Life History.—The life history of the parasite has not been completely investigated. The eggs, and young worms which have been hatched out, are expelled by coughing and by the bowels after the phlegm from the lungs has been swallowed. The worms live for some time in water or moist soil and probably undergo changes outside the body which enable them to live and develop when they gain access to the system of a calf. It is not known how the parasite reaches the lungs, but possibly the immature forms (eggs and embryos) are swallowed with food or water, and are carried to the lungs by the blood stream. They develop into adult worms capable of producing young, and so give rise to a fresh crop of young worms. Although the actual cause of the disease is the parasite, external conditions favour its increase. Wet seasons (which favour the preservation of the immature forms), low-lying land, poor condition of the calves, and overstocking are all favourable to the spread of the disease.

Symptoms.—The symptoms depend to some extent on the degree of infection. The worms cause inflammation of the tubes of the lungs (bronchitis), and this results in a husky cough. Phlegm is coughed up, and in severe cases it may be mixed with blood; it often contains thread-like worms. In severe cases an animal may die suddenly of suffocation. Usually unthriftiness and a cough are the chief symptoms.

Treatment.—The treatment should be both (*a*) preventive, and (*b*) medicinal :—

(*a*) If pastures are very badly contaminated it may be good policy to plough them up and crop the land. Calves should be given a liberal diet and should be kept from pastures on which infested animals have run, especially if the pastures have been overstocked or are naturally damp and undrained.

(*b*) It is a popular belief that if volatile drugs, such as turpentine, are given by the mouth, the vapours are given off by the lungs, and exercise a poisonous effect on the parasites. While it is correct that the vapours of such drugs may be excreted by the lungs, the amount so excreted is never sufficient to affect parasites, and therefore treatment of this kind *cannot* be effective.

The injection of drugs into the windpipe, and fumigation by poisonous gases, give good results, but these methods should only be undertaken with the advice and under the supervision of a veterinary surgeon.

THE USE OF STRAW FOR FODDER.

THE following facts and suggestions have been compiled by the Animal Nutrition Institute, Cambridge, at the request of the Board of Agriculture and Fisheries, for the benefit of farmers who propose during the coming winter to extend the use of various kinds of straw for fodder.

In considering the value of any material for fodder the first point which arises is the composition as shown by analysis. Unfortunately for the present purpose, it is unusual in Great Britain to buy or sell any kind of straw for fodder. Consequently there has been little need of analysing straws from the point of view of their use as fodder, and very little information as to the composition of British-grown straws is available. The figures given in the ordinary text books and dictionaries are derived almost exclusively from German sources, and are of comparatively little practical use in the case of a substance like straw, the composition of which so obviously varies with date of cutting, methods of harvesting and thrashing, time of sowing, and so forth.

Back volumes of *The Journal of the Royal Agricultural Society* record analyses of most kinds of straw made by the late Dr. A. Voelcker, but methods of analysis have changed

so much since the date of these analyses that they can scarcely be considered as reliable now. In the case of oat straw a large number of samples were analysed quite recently by Aitken and Hendrick, whose results are recorded in the Transactions of the Highland and Agricultural Society. From these and a few other scattered analyses, together with a number of analyses made at Cambridge for the special purposes of this article, Table I. has been compiled, which gives British analyses of several kinds of straw, and German analyses only where no British figures are available. The analysis of average meadow hay is included in the table for purposes of comparison. The figures are all calculated on the basis of 14 per cent. of moisture, the standard average content of moisture in ordinary samples of all kinds of hay and straw as used for fodder. The time at our disposal did not admit of complete analyses, and, therefore, Voelcker's figures for fat have been adopted. No appreciable error can result from this, as the percentage of fat in all cases is very small, and the method of fat estimation is practically the same now as when Voelcker's analyses were made.

TABLE I.—*Composition of Different Straws.*

Description of Straw.	Protein N x 6·25.	Fat.	Carbo-hydrates.	Fibre.	Ash.	Source of Analyses.
Wheat, winter ...	1·86	1·11	37·4	40·6	4·9	Cambridge.
Wheat, spring ...	2·03	1·11	40·5	38·5	3·7	Cambridge.
Barley, spring ...	3·89	1·16	38·0	39·7	4·2	Cambridge.
Oats, spring... ...	2·77	2·91	43·1	32·1	5·2	Aitken & Hendrick.
Rye, winter ...	3·11	1·39	37·3	40·0	3·9	German.
Rye, spring	3·16	1·56	41·7	36·9	2·6	German.
Bean, winter ...	4·74	1·09	29·4	45·8	4·8	Cambridge.
Bean, spring ...	5·97	1·09	27·4	45·2	6·1	Cambridge.
Bean, pods and cavings	10·10	—	41·4	29·2	5·4	Cambridge.
Pea	9·00	1·90	32·3	36·2	6·3	German.
Meadow Hay ...	9·50	2·30	40·3	27·6	6·0	Average.

The figures given in Table I. and the German figures of the text-books agree remarkably well, except in a few cases. For example, the German figures indicate that oat straw has about the same feeding value as barley straw. The British figures, however, give to oat straw an appreciably higher value than barley straw, a conclusion with which practical men will generally agree. Bean straw, on the other hand, appears to be flattered by the German figures, whilst German pea haulm does not appear to come up to the standard accepted in British practice, although it has not been possible

to find any reliable British figures in confirmation. The variations noted are probably due to difference in date of cutting, the inclusion of varying proportions of flag and stem according to the methods of harvesting and thrashing, and, no doubt, to the culture of different varieties. It should also be mentioned that each figure given in the table is the average of the analyses of several samples, which do not always agree very closely amongst themselves. It must be understood, therefore, that British straws of the same kind are not all of the exact composition given in the table. Considerable variations occur between one district and another, one variety and another, and so forth.

Farmers are getting accustomed to interpreting for themselves analyses of cakes and meals, which they commonly buy. In the case of these concentrated feeding stuffs, which contain little fibre, nearly all the constituents indicated by the analysis are digestible, and the analysis is consequently a fair measure of their feeding value. In the case of bulky foods like straws, however, where only about half the constituents shown by the analysis are capable of digestion, the figures of an ordinary analysis are likely to give quite a wrong impression of their relative value.

So far as can be found, no determinations of the digestibility of straws have been made in Great Britain, but by applying German digestibility figures to British analyses it has been possible to arrive at the figures given in the first four columns of Table II. From these figures the last four columns have been calculated.

TABLE II.—*Digestible Nutrients per* 100 *lb. Straw.*

Description of Straw.	Protein.	Fat.	Carbo-hydrates.	Fibre.	Nutritive Ratio.	Food Units.	Starch Equivalents		Source of Information.
							For Maintenance.	For Production.	
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Wheat, winter ..	0·30	0·40	13·9	19·9	1:115	33·5	35·0	11·2	Camb.
Wheat, spring ..	1·19	0·04	16·4	19·2	1 : 30	38·7	37·2	14·5	Camb.
Barley, spring ..	0·67	0·48	17·0	21·5	1 : 59	41·4	40·3	17·2	Camb.
Oat, spring ..	0·72	1·12	19·4	17·6	1 : 54	41·6	40·7	21·9	Aitken & Hendrick.
Rye, winter ..	0·77	0·71	15·3	22·4	1 : 51	41·4	40·1	16·8	German.
Rye, spring ..	1·01	0·82	20·0	20·3	1 : 41	44·9	43·2	21·7	German.
Bean, winter ..	2·08	0·62	19·8	19·6	1 : 20	46·1	43·7	16·5	Camb.
Bean, spring ..	2·72	0·62	18·6	19·4	1 : 15	46·4	42·6	17·1	Camb.
Bean, pods and casings..	5·05	0·62	27·5	12·5	1 : 8	54·2	47·5	29·3	Camb.
Pea	5·10	1·18	17·2	11·4	1 : 6	44·3	37·4	11·7	German.
Meadow Hay ..	5·42	1·17	25·8	16·3	1 : 8	58·6	51·8	33·1	Average.

The figures in the last four columns require some explanation. Column 5 gives the nutritive ratios of the different straws. The nutritive ratio shows the relative proportions of protein

(or flesh-formers) to carbohydrates and fats (or heat-formers). For instance, the ratio 1 : 115 assigned to wheat straw means that in this fodder there are 115 lb. of carbohydrates and fats for every 1 lb. of protein. It will be noted that the ratios in the table vary from 1 : 115 to 1 : 6. The ratio required by most animals is somewhere between 1 : 5 and 1 : 10 according to the age of the animal and the purpose for which it is being fed.

For comparison with the figures given in " Notes on Feeding Stuffs " which appear in this *Journal* each month, the food units contained in each variety of straw are given in column 6. These figures are, however, not instructive as applied to straw, since they are calculated on a basis which includes an allowance for the manurial value. This is fair as between the buyer and seller of cakes and other concentrated foods, but does not apply to the case of bulky materials like straw, which are not sold for fodder to any appreciable extent. Farmers know well enough the manurial value of their straw. What they want to know is the food value.

The figures in columus 7 and 8, headed " starch equivalents," express the relative feeding values of different kinds of straw, without any allowance for manurial value. The figures give the number of pounds of starch which have the same feeding value as 100 lb. of the fodder, starch being always taken as the unit of comparison in valuing foods. It is necessary to calculate two starch equivalents for each fodder, because in most cases the food an animal eats has to perform two functions :—(1) some of it is used to keep the body warm and to provide the energy for the ordinary vital functions, food used in this way being said to be for " maintenance " ; (2) some food is eaten above that required for maintenance, and is used by the animal for " production " of growth, fat, milk or work. The whole of the energy of the digestible portions of the food is available for " maintenance," and the starch-equivalents of straws for this purpose are comparatively high. For example, the figures in column 7 show that for maintenance 100 lb. of wheat straw are equal to about 35 lb. of starch, 100 lb. of barley straw are equal to about 40 lb. of starch, and so on. Straws are, therefore, suitable materials for that portion of the diet which is concerned with the maintenance of the animal.

It is noteworthy that the figures showing the starch equivalents for " production " in column 8 are much smaller. Thus for the production of meat, milk, or work, 100 lb. of wheat straw are equal to not more than about 11 lb. of starch, or rather

less than one-third as much as the starch-equivalent for maintenance. The reason of this is that straws are very bulky foods, containing comparatively small amounts of digestible nutrients combined with large quantities of indigestible fibre. The work of chewing and digesting such bulky fibrous material uses up something like two-thirds of the energy of the nutrients which are digested, and thus only one-third is left over for production of growth, milk, meat, or work. Although this energy used in digestion is no good for production, it is as good as any other energy for keeping the body warm. The low figures in column 8 may be taken as proof that straws are of little use for productive purposes. Their proper use is to help to make up the maintenance portion of the ration, the productive portion being made up of other foods which are more concentrated and more digestible. Thus straw will maintain the weight of a runt during the winter, but no amount of straw will fatten him.

Wheat straw, as shown by the figures for starch equivalents, has the lowest feeding value of any of the materials included in the list of straws. Its stiff and elastic nature also makes it less palatable than other straws, but these very properties cause it to absorb liquids more effectively, and make it the best of all straws for litter.

Barley straw has considerably greater feeding value than wheat straw, and, excepting the awns, is more palatable. Its softness and lack of elasticity make it a less effective absorbent of liquids, and it is therefore not so good for litter.

Oat straw is more palatable and more readily eaten by stock of all kinds than any other cereal straw. Consequently, little of it is used for litter. It has about the same value for maintenance as barley straw, but its *value for production is considerably higher;* hence it is better than other straws for growing animals.

Rye is little grown in Great Britain, and it has not been possible to find any analyses of British-grown rye straw. Most of the small quantity grown in this country is used for packing purposes.

Bean straw differs from the cereal straws in the much higher content of protein, as will be seen from its nutritive ratio. The softer and more brittle portions included in the cavings have a still higher food value, approximating to that of average meadow hay.

Pea haulm has the reputation amongst practical men of being equal in value to hay. The German figures quoted in the tables do not bear out this opinion, and no British analyses which appear to be trustworthy are available.

Practical men hold various opinions of the food value of bean and pea straw. When the whole of the straw is chaffed the food value is low because the woody stems decrease the digestibility, but where the stock are allowed to pick out the leaves and pods, and discard the stems, the food value of what is picked out is about that of hay, as shown by the analysis quoted of pods and cavings.

Increasing Palatability and Digestibility.—As shown by the analyses quoted in the table, all the straws contain large quantities of nutrients, but, on account of their unpalatableness and low digestibility, only a comparatively small proportion of the nutrients is of use to the animal. Many suggestions have been made for increasing the palatableness of straws and making them more digestible. The former object is sometimes achieved by chaffing the straw and mixing it with pulped or cut roots in the proportion of 1 part by weight of chaff to 9 parts by weight of roots. The mixture is allowed to stand for at least 12 hours before it is fed to the stock. As the season advances and the straw and the roots get drier, the mixture may be moistened with treacle mixed with warm water and sprayed on with a watering can. The straw on standing in contact with the roots absorbs water from them, and the fermentation which results warms the mixture and softens the straw. No doubt, this treatment makes the straw more palatable, but so far as it has been possible to ascertain there is no evidence that its digestibility is increased.

For horses getting all their bulky food in the form of straw it is good practice to allow the horse-keeper about half a stone of linseed cake per horse per week. This is mashed in a tub with water. When the cake is thoroughly softened it is stirred up, and the liquid used to moisten the chaff. This mixture is readily eaten, and gives good results.

Another time-honoured method is to sandwich layers of cut green stuff amongst the chaff when it is put in the chaff house. The amount of green stuff used is small. Late cuttings of seeds, lucerne, or almost any late green stuff, will answer the purpose. The mixture is solidified by the feet of the men who spread out the cut green stuff, and a slow fermentation results. After standing some weeks or months the mixture develops a pleasant smell and is readily eaten by any kind of stock.

Steaming is also sometimes resorted to. This, no doubt, softens the straw, but there appears to be no definite evidence that it increases the digestibility. The digestibility, however, is undoubtedly increased by boiling with alkali, but such

treatment is beyond the resources of the ordinary farmer. It is possible that all the processes in which fermentation is set up may increase the digestibility. This question is now under investigation.

Attention has already been directed to the great variation in the feeding value of different parts of straw. Although no analyses can be quoted to prove the point, there can be little doubt that the leafy portions of straw are more palatable, more digestible, and consequently of greater feeding value than the stems. This knowledge can be turned to practical account in two ways. In the first place the threshing machine, to a certain extent, separates these two parts of the straw. The softer, leafy portions are broken in their passage through the machine, and delivered separately in the form of what is usually called cavings, which should be carefully preserved and used in place of hay. Such cavings are undoubtedly of greater feeding value than the straw proper. This statement applies only to the broken leafy parts of the straw and not to the husks of the grain which, especially in the case of barley awns, are apt to irritate the eyes of stock.

Cavings are particularly valuable in cases where clover or other seeds were sown with the corn. In such cases the cavings contain nearly all the leaf of the "seeds," and their value will consequently be nearly that of good hay.

Separation is readily made by the animals if the method of giving long straw is adopted. In this method nearly the whole allowance of straw intended for both food and litter is placed in racks or bings. The animals pick out much of the softer, leafy parts, and strew the hard, stemmy portions under their feet. The small amount which was kept back is then spread by the attendant.

In cases where the supply of straw is so short that it does not suffice for both fodder and litter, the whole of it may be used for fodder, a substitute being used for litter. Very fair litter may be made by using dried bracken where this is available. In other cases peat-moss litter is invaluable, and may at the present time be bought in large quantities at something under £2 per ton. With care, 1 ton of peat moss will replace from 2 to 3 tons of straw. Where it is necessary to use all the straw for fodder it is advisable to adopt one or other of the methods suggested above for increasing its palatability.

Rations.—The following rations are given as instances of the practical application of the suggestions made above:—

Horses.—Where the supply of hay is short the following rations should be tried, per head per day:

Oat straw, long, in racks	10 to 12 lb.
Chaff or cavings	8 ,, 10 ,,

If any hay at all is available the chaff should be mixed hay and straw, half and half. If no hay can be spared, the straw chaff should be moistened before it is used with a mash of linseed cake and water at the rate of about 1 lb. of cake per head per day. At the present high price of linseed cake it is tempting to suggest that rice meal should be used in its place, choosing, of course, a sample rich in oil. The writers have no personal experience of such use of rice meal, but know of cases where it has proved successful, and see no reason why it should not be satisfactory. Rations for horse corn are given in the monthly notes on feeding stuffs on p. 680.

Cows or other Horned Stock.—Where these are kept in boxes or yards they should be given long straw in their bings or racks at the rate of about 25 lb. per head per day. From this they will pick out what they require of the more palatable and digestible portions and strew the rest under their feet for litter. Cows or bullocks do well on long barley straw fed in this way. They should also get cavings in place of hay, or chaff mixed the day before use with about 9 or 10 times its weight of cut or pulped roots. Where roots are short, or towards the end of the season when they get drier, owing to storing, half the proportion of roots may be used, the chaff being damped with a mixture of warm water and treacle.

ON 28th September an appeal in the following terms was made by the President of the Board of Agriculture and Fisheries to farmers and occupiers of land in England and Wales:—

Appeal by Lord Selborne to the Farmers and Occupiers of Land in England and Wales.

As Minister of Agriculture in this present time of War, I desire to appeal to you who live by the land to assist your King and Country by producing as much food as possible on your holdings in the coming year. It is always a wise precaution for a nation at war to provide as much food as it can within its own borders. You must remember that this war has to be fought with money as well as men, and every additional pound's worth of food which you can grow means a reduction in the quantity to be purchased from abroad and is, therefore, a direct contribution to victory.

The chief needs of the nation are more wheat, meat, milk, oats, potatoes, bacon, and cheese. I cannot hold out any hope of a special financial inducement from the State; on the other hand I do not ask you to do anything which would diminish the capital necessary to enable you to farm well, but, subject to this reservation, I ask you to do your part in producing larger quantities of the commodities mentioned above as the special war service which you can render to your country. I invite also, all market gardeners, cottagers, and allotments holders to do their share by increasing the production of vegetables, pigs, and poultry, and by living on the produce from their gardens and allotments as far as possible. By this means they will save money for themselves and increase the amount of food available for others.

The conditions of farming vary so much in the different localities that I cannot attempt to make any general recommendation for your guidance as to the means you should adopt for increasing the production of food on your holding. That must be left to your judgment and to the advice of your friends and neighbours. But I suggest that you should consider whether you cannot attain the object in view by one or more of the following methods:—

(*a*) By ploughing up those of your poorest permanent grass fields which are suitable for conversion, and so increasing your arable land.

(*b*) By shortening the period for which your existing arable land is kept under clover or rotation grasses.

(*c*) By improving your remaining grass land so that it will carry more stock.

(*d*) By reducing your acreage of bare fallow wherever possible.

I realise that increased production cannot be obtained without a great effort, and that farmers have to face many special difficulties in these times. It is my desire to help you to overcome these difficulties by all the means in my power.

The chief one which now confronts you is that of labour, and in this connection I have arranged with Lord Kitchener that, as soon as the analysis of the National Register has been completed, men of the classes of Working Farm Bailiffs, Shepherds, Stockmen (including Milkers), Horsemen, Thatchers, Engine Drivers, and Mechanics and attendants on agricultural machinery, steam ploughs and threshing machines will not be accepted for enlistment, even if they should offer themselves.

This valuable concession will enable you to retain the services of your skilled workers, upon whom I desire to impress that they are serving their country best by remaining at their accustomed occupations. But the difficulty will still remain in respect of the supply of ordinary farm labour. The staff of the Board of Agriculture are ready to assist you as far as possible, but they cannot cover the whole country, and in order to help you in respect of the supply of labour and of any other difficulties which may arise, I have asked the County Councils to assist the Board of Agriculture, and they have willingly agreed to do so. Steps are being taken for the appointment in each County of a War Agricultural Committee, representative of all the agricultural interests of the County, and for the appointment of local Committees in each District. I ask you to consult these local Committees on any problems and difficulties which may confront you. They will consist of your neighbours and friends who know the local conditions, and in many cases they will be able to assist and advise you. If they cannot do so, they will refer to the County Committee which will have at its disposal the services of the County staff for agricultural instruction and of the experts connected with the Provincial Councils for Agricultural Education, and which will be in touch with all the available sources of the supply of labour. The County Committee will be assisted by a representative of the Board of Agriculture and will report any special difficulties to the Board.

By means of this machinery it will be possible for me, as Minister of Agriculture, to be kept informed of the needs of farmers throughout the country, and to secure that all the help that can be given to you is placed at your disposal.

I ask you for your part to devote all your energies to the task that is set before you, and I am confident that I shall not ask in vain.

The World's Supply of Potash.

A COMPREHENSIVE review of the world's supply of potash is made in a pamphlet issued by the Imperial Institute (*The World's Supply of Potash*, price 1s., post free). The supplies of potash from deposits of soluble potash minerals, salt lakes and brines, sea-water, vegetable sources, wool washings, nitre-earths, and insoluble potash minerals are in turn considered.

Besides those worked at Stassfurt there are ***deposits of soluble potash minerals*** in Alsace, in Austria, in the Punjab, at two places in Chile, and in Catalonia (Spain), the Catalonia deposits

offering one of the most promising fields for the supply of potash minerals that have been recorded for many years past.

Lake basins containing potash are found in the United States, but in only a few cases have potash salts been located in quantity likely to repay working. One of the most promising is Searles Lake, California, which, it is estimated, may yield from four to six million tons of potassium chloride. No potash salts have so far been produced from the salt lakes or brines in India.

With regard to *sea-water*, which contains on the average about 0·25 per cent. of potash salts, it is thought that at the present time it might pay to recover potash from residues usually run back into the sea at large works for the recovery of salt from sea-water such as exist in France, Portugal, the United States, and India. It has recently been stated that the total output of potash salts from sea-water is about 2,000 tons per annum. The cost of production is stated to be, in the United States, about 13*s.* per ton of potash salt produced by means of a direct extraction process.

Seaweed is the only vegetable source of potash promising to become a formidable competitor with the mineral sources. Besides being used raw as a manure (see Leaflet No. 254) potash is obtained from burnt weed (kelp) in Scotland, Ireland, Norway, Japan, and the United States. In the last-named country it is estimated that six million tons of potassium chloride per annum could be obtained from the giant algae of the Pacific Coast (which are said to contain five times as much potash as ordinary species of seaweed). The cost per ton of weed landed averages 10*d.*

There are two methods of using this Pacific Coast seaweed :—

(1) After drying, the residue is ground and used as a potash and nitrogenous manure. Heating up to 100° C. gives a good manurial product, but a still better is obtained if the heating is continued to 200° C. Dried at 105° C., the *Nereocystis* weed contains, on the average, 19 per cent. of potash, 2 per cent. of nitrogen, and 47 per cent. of organic matter ; 500 tons of wet weed produce 75 tons of dry, and 1 ton of dry weed costs about 20*s.* 6*d.* to produce. On the basis of only 15 per cent. of potash and 2 per cent. of nitrogen, then with potash at 10*s.* 5*d.* a unit and nitrogen at 2*s.* 8*d.* a unit, the material should be worth 61*s.* 6*d.* a ton. It is suggested that this material could replace efficiently much of the low-grade potash salts now employed as manure.

(2) The weed is used as a source of potash salts, the other by-products being recovered at the same time. By these processes 100 tons of wet weed give 11,000 lb. of potassium chloride, 7,680 lb. of manure salts, and 400 lb. of calcium carbonate, besides other by-products.

Owing to its very low content of potash, large quantities of *wood ash* are necessary for the production of appreciable quantities of potash, and the production of potash from this source is only remunerative where large quantities of waste wood are available, or where much is used as fuel and the ashes are easily collected. In most cases the only use for the ash from saw-mill burners is its employment directly on the land by farmers in the locality.

As regards *vegetable waste* the use of hedge clippings and trimmings has been dealt with in this *Journal* (Nov., 1914, p. 694). It appears that some 7,000 tons of crude potash from sunflower stalks were exported from Russia in 1913. Potash is also obtained from the residues from sugar beet manufacture (" vinasse ").

The sweat from raw *wool washings* contains potash which can be removed by treating with water. In the United States wool washings are run through peat which absorbs the potash, and processes are in operation in Belgium, France and Germany for obtaining the potash from the washings. The annual production of potash from this source is from 5,000 to 10,000 tons of potash as K_2O; in the Roubaix district of France alone, potash salts to the value of £100,000 are annually obtained in this way.

Nitre-earths are found in the soils of old village sites in India, Egypt, Persia, Hungary, Italy and Poland, but India is the only country from which large quantities of potassium nitrate obtained from this source are exported, 14,157 tons, to the value of £233,000, being exported in 1914.

Of *insoluble potash minerals* probably one of the most promising is alunite, which is found in Italy, Australia, India, Canada and the United States, the supplies in the last-named country containing as much as 10·46 per cent. of potash as K_2O. Various methods of treatment are being carried out. Calafatite, found in Spain, contains 9·64 per cent. of potash as K_2O. Large quantities of felspars are available at low prices, so that considerable attention has been directed to converting the insoluble potash present into a soluble form, several processes being tested at the present

time; no considerable quantity of potash has, however, yet been produced from this source and the processes do not seem capable of competing, under normal conditions, with salts from the Stassfurt deposits.

During the past few years attention has been directed towards the possibility of employing as manures, with or without previous treatment, minerals and rocks which contain potash insoluble in water. The more important of these are alunite, felspar and leucite. As a general rule, however, it may be concluded that their employment is not likely to prove remunerative unless the material is available in large quantity at a low price. Even under these conditions its use may not prove satisfactory. The manuring of land with insoluble potash minerals has the advantage, however, over the use of kainit and similar compounds, that the valuable constituent only becomes "available" slowly, and is, therefore, not washed out of the soil. Minerals containing insoluble potash are employed as manures in Italy, Austria, Russia and Germany.

Compound Manures.

IN view of the fact that farmers, for convenience and other reasons, frequently have recourse to "special" or compound manures supplying in greater or less degree most or all of the food constituents required by plants, a list of simple mixtures is given below which, under present conditions, might be used for the different farm crops. Such general mixtures, however, will probably be neither the cheapest nor the most suitable in exceptional circumstances, and must be used with discretion. The total quantities stated should be sufficient for one acre under average conditions.

Other manures can be mixed together to give approximately the same composite analyses, but only such as do not interact on each other chemically should be used for this purpose.

In each case the percentage composition of the mixture has been ascertained by multiplying the weight (in cwt.) of each manure by its content of nitrogen or phosphate, as the case may be, and dividing by the total weight of the mixture. (See example below.)

In making these mixtures the several ingredients should be very thoroughly incorporated in small quantities, and used without undue delay.

The manures used are *Sulphate of Ammonia* containing 20 per cent. of nitrogen, *Superphosphate* containing 30 per cent. of soluble phosphate, and *Steamed Bone Flour* containing 1 per cent. of nitrogen and 60 per cent. of insoluble phosphate. It is assumed that potash in the form of kainit, sulphate, or muriate of potash is unobtainable, or, at all events, is too expensive for general use.

Wheat, Oats, Barley.—

					Per cent
$\frac{3}{4}$ cwt.	Sulphate of Ammonia	containing	Nitrogen	$= \frac{3}{4} \times 20 \times \frac{8}{25}$	= 4 8
2 ,,	Superphosphate		Sol. Phos.	$= 2 \times 30 \times \frac{8}{25}$	= 19·2
$\frac{3}{8}$,,	Steamed Bone Flour		Nitrogen	$= \frac{3}{8} \times 1 \times \frac{8}{25}$	= ·1
			Insol. Phos.	$= \frac{3}{8} \times 60 \times \frac{8}{25}$	= 7·2

The analysis of the mixture is, therefore :—4·9 Nitrogen ; 19·2 Soluble Phosphate ; and 7·2 Insoluble Phosphate.

Mangolds.—

				Per cent.
1½ cwt.	Sulphate of Ammonia	containing	Nitrogen	= 6·1
3 ,,	Superphosphate ..		Sol. Phos.	= 18
½ ,,	Steamed Bone Flour		Insol. Phos.	= 6

Swedes, Turnips.—

				Per cent.
¾ cwt.	Sulphate of Ammonia	containing	Nitrogen	= 3·4
3 ,,	Superphosphate ..		Sol. Phos.	= 19
1 ,,	Steamed Bone Flour		Insol. Phos.	= 12·6

Potatoes, Carrots.—

				Per cent,
1¼ cwt.	Sulphate of Ammonia	containing	Nitrogen	= 4·3
4 ,,	Superphosphate		Sol. Phos.	= 20
¾ ,,	Steamed Bone Flour		Insol. Phos.	= 7·5

Beans, Peas, Lucerne, Sainfoin.—

				Per cent.
½ cwt.	Sulphate of Ammonia	containing	Nitrogen	= 2·0
4 ,,	Superphosphate		Sol. Phos.	= 21·8
1 ,,	Steamed Bone Flour		Insol. Phos.	= 11

"*Seeds*" *Hay.*—As for Oats.

Meadow Hay.—

				Per cent.
1 cwt.	Sulphate of Ammonia	containing	Nitrogen	= 4·5
3 ,,	Superphosphate		Sol. Phos.	= 20
½ ,,	Steamed Bone Flour		Insol. Phos.	= 6·7

Pastures.—

				Per cent.
½ cwt.	Sulphate of Ammonia	containing	Nitrogen	= 2·1
4 ,,	Superphosphate		Sol. Phos.	= 24
½ ,,	Steamed Bone Flour		Insol. Phos.	= 6

AN increase in the production of cheese is recommended both because of the present high prices and also as a contribution to the national food supply.

The Importance of Producing More Cheese.

Cheese is the form in which milk can best be preserved as a food; it is particularly suitable in a diet on which prolonged physical work has to be performed; and it is a very good substitute for meat.

Most of the present methods of using milk give rise to avoidable waste.

1. *Milk Selling.*—As a result of imperfect organisation among farmers, milk which is in excess of what is required to fulfil the farmer's sale contract is often put to a comparatively unprofitable use. Even if the individual farmer did not himself undertake cheese-making, co-operative depots might enable large quantities of surplus milk to be converted into cheese during the "flush" season (May and June) and thus add to the food supply.

2. *Butter-making.*—Under present conditions the use of large quantities of milk for the production of butter is wasteful, since wholesome and economical substitutes for butter are available, and butter represents less than half the food in the milk required for its manufacture. Further, the replacement of butter by cheese would be profitable, as a consideration of the following fairly typical example will show:—

	s.	d.
2½ gal. milk produce 2½ lb. Cheese at 10*d.*	2	1
2½ „ „ 1 lb. Butter at 1*s.* 2*d.*	1	2
Profit in favour of cheese over butter	0	11
Less the greater value of the by-products from butter over cheese manufacture	0	3
Net profit	0	8

or, say 3*d.* per gal. of milk.

3. *Calf Rearing.*—The use of whole milk for calf rearing is to a large extent wasteful, since experiments have shown that early in the calf's life (say, from about the third week) whole milk may be gradually replaced by substitutes. Information as to the use of milk substitutes in calf rearing is given in Leaflet No. 142 (*Calf Rearing*).

Type of Cheese to Make.

The kind of cheese to be made is dependent principally on the amount of milk available, and the local markets. With a surplus of from 15 to 20 gal. and upwards available daily for cheese-making, a wide range as to the kind of cheese is possible, but the following varieties are especially recommended :—

Quantity of Milk available.		*Kind of Cheese.*
15–20 gal.	..	Caerphilly, Single Gloucester.
20–40 „	..	Derby, Double Gloucester, Truckle Cheddar.
over 40 gal.	..	Cheddar, Cheshire, Leicester, Lancashire, Derby.

Where under 15 gal. are available daily, cheese-making will be restricted either to hard cheeses of the type sometimes described as "Small Holder" cheeses or to soft cheeses. The manufacture of the latter kind, however, is advisable only in localities where a ready market is available, since soft cheese does not keep well. "Small Holder" cheeses are superior in this respect, and, if properly made, can be kept in a saleable condition for a considerable time.

Notes on the manufacture of soft cheeses are given in Leaflet No. 179, and on hard cheeses suited for producers of small quantities of milk in Leaflet No. 231. (As to the latter an article in the *Journal* for June, 1911, p. 193, on the "Kingston" cheese for small holders, may also be consulted.)

The cost of cheese-making apparatus may be as low as £1 in the case of small hard or soft cheeses ; but for the manufacture of the larger types of cheese an outlay of from £15 to £30, or even more in the case of large dairies, becomes necessary.

Most county education authorities provide instruction in cheese-making, and are prepared to give cheese makers all possible advice and assistance (see also Special Leaflet No, 25, *Technical Advice for Farmers*).

THE following note has been communicated to the Board by Mr. G. C. Sankey :—

The Use of Stubbles for Poultry.

In some districts it has been the custom for many years past to move poultry on to the stubbles directly the corn has been carried. Where the necessary precautions are taken the practice has proved very successful and it might with advantage be more widely adopted, especially now that the increased price of feeding stuffs renders any economy in feeding a matter of importance.

Poultry thrive best on the wheat stubbles; they do not always take readily to the oat and barley stubbles unless they have been accustomed to these grains previously. The most satisfactory course is to put the birds on to the latter stubbles first; if they do not at once relish the grain they will wander over a greater range and scratch in the hope of finding more attractive food, and in this way will destroy a large number of grubs.

The chief difficulties met with in keeping poultry on the stubbles are (1) the unsuitability of the average farm poultry house for the purpose, and (2) the danger of foxes.

The house should be a portable one. It should be made in sections of strong ¾-in. seasoned match-board, and ample ventilation should be provided; a convenient size is 8 ft. by 6 ft. The body should be mounted on wheels of not less than 12 in. diameter and possessing broad rims to prevent them sinking into the ground in wet weather. In moving the houses the traces are best attached to the axle itself and not to hooks placed on the front of the house. The house should be placed on a high but not exposed position and never near a wood or thick hedge that is likely to harbour vermin such as foxes and stoats.

Perhaps the greatest drawback to keeping poultry on stubbles is the danger of loss by foxes. There seems to be no effective means of keeping these pests away, and the only course is to take all precautions that are possible. The house should always be closed up at dusk and the fowls should not be allowed out in the morning until the dew is off the field. Wire netting is usually effective, but there is always the possibility that the fox will get over or under it. It has been suggested that pieces of tarred felt placed round the house and a light inside the house would keep foxes away, but the writer has not found these measures of much use. Special precautions should be taken when there is any pheasant shooting in the neighbourhood, as when a fox is disturbed by the beaters it will often roam about for two or three days before returning.

Pullets, unless hatched very late, should never be put on the stubbles; the abundance of food they obtain there forces them on too rapidly, with the result that they commence to lay a month or six weeks sooner than they ought to, and after laying about 25 to 30 eggs they stop and will not as a rule start again until the spring when eggs are plentiful. The most suitable birds to be put on the stubbles are growing cockerels and hens that have been sitting and are consequently in poor condition.

The first day the fowls are put on the stubbles they should not be allowed out until about an hour before dusk, otherwise difficulty will be experienced in getting them into the house again. After the first day, the time that the birds are allowed out must be determined by the farmer. This is best done by feeling their crops in the evening. As the ground becomes stale the house should be moved, care being taken that it always faces south. A plentiful supply of water, which should be left in a shady place and should be renewed daily, must always be provided.

Notes on Feeding Stuffs in October: *From the Animal Nutrition Institute, Cambridge University.*

WHEN these notes* were begun six months ago they were prefaced by an introduction setting out the general principles of feeding. After the lapse of this time, and especially as the approach of winter entails different conditions of feeding, it may not be out of place to refer once more to general principles. The following remarks are intended to make clear several points bearing on the purchase and use of feeding stuffs, six months' experience in preparing these notes having shown them to be frequently misunderstood.

In order to purchase feeding stuffs to the best advantage it is necessary to know exactly what one requires to buy. The first step in obtaining this knowledge is to understand the composition of the common home-grown fodders which are usually available on any farm where stock are kept. The following table gives the percentage of digestible nutrients in the common home-grown fodders :—

Name of Fodder.	Digestible Nutrients per Cent.				*Nutritive* Ratio.
	Protein.	Fat.	Carbo-hydrates.	Fibre.	
Meadow hay	4·65	1·01	22·2	14·0	1 : 8
Oat straw	0·77	1·14	19·8	18·0	1 : 52
Barley straw	0·67	0·48	17·0	21·5	1 : 59
Wheat straw	0·30	0·40	13·9	19·9	1 : 115
Bean straw	2·72	0·62	18·6	19·4	1 : 15
Turnips	0·1	0·1	5·6	0·5	1 : 63
Swedes	0·2	0·1	7·1	0·6	1 : 40
Mangolds	0·15	0·1	8·5	0·5	1 : 60

The figures in the above table give the number of pounds of each kind of digestible nutrient in 100 lb. of each kind of fodder. They convey a good deal of useful information to anyone who understands the fundamental principles of

* This *Journal*, April, 1915, p. 52.

nutrition. For the sake of readers who do not understand these principles a few lines of information may be of value.

Digestible Nutrients.—This term is very generally misunderstood. When an ordinary article of human food is described as digestible most people take the description to mean that it may be eaten without causing the particular kind of discomfort which is called indigestion. Similarly an article of food which gives rise to discomfort after it is eaten is said to be indigestible. The digestive arrangements of farm animals are very different from those of human beings, and the meaning of the term digestible as applied to foods for animals is not the same as that indicated above. To understand the meaning of the term as used in reference to the feeding of animals it must first be recognised that only that part of the food which is digested is of any service to an animal. The amount of digestible nutrients in any food is found by feeding an animal on a known weight of the food for a week or even a fortnight. During this period the animal's dung is carefully collected and weighed. Both the food and the dung are then analysed, and by subtracting the amounts of the various nutrients voided in the dung from the total amounts eaten in the food the amount of each nutrient which has been digested is found. The figures given in the table were ascertained in this manner.

Nutrients.—Only certain constituents of foods are of service to the animal, namely, proteins, fats, carbohydrates, and ash. These constituents are known as nutrients. They are described below.

Proteins.—The working parts of the body of an animal, namely, the muscles (lean meat), nerves, glands, and so on, are made of proteins. Like any other things which do work they undergo wear and tear in the process, and this wear and tear must be replaced from day to day. For this purpose proteins must be supplied in the food, or the animal loses weight and its health suffers. No other nutrient can take the place of protein for this purpose. It is just as reasonable to attempt to repair the bearings of a steam engine with a piece of coal as to try to make good the wear and tear of the muscles of an animal by feeding it on fat or sugar. It must also be remembered that in young animals where growth is taking place the working parts are increasing, and for this a liberal supply of proteins in the diet is necessary. An extra supply of proteins is also required for pregnant animals or animals giving milk, for in both cases the mothers have

to supply large quantities of proteins for the growth of their young.

Fats or Oils are perhaps more familiar to most people than proteins. They are useless for repairing the working parts of the body, or for providing material for the growth of the muscles of young animals. They have nevertheless a very high feeding value because the animal can utilise them in its body for providing heat and work. If an animal eats more fat than is necessary to keep it warm, and to carry on its vital functions, such as breathing, heart beat, and mastication, the balance can be stored up as fat.

Carbohydrates include such well-known substances as sugar, starch, and digestible fibre. Like the fats, they are useless for repairing the working parts of the body, and, again like the fats, they can produce in the body heat and work. If the diet supplies more carbohydrates and fats than are necessary for keeping the animal warm, and providing the energy for carrying on its usual vital functions, the balance can be used by the body for the production of increased weight in the form of fat, for the provision of the sugar and fat in milk, or for enabling the animal to pull a load, or to do any other work which may be required of it.

It is a common practice to call the proteins " flesh formers " and the fats and carbohydrates " heat formers."

Ash.—Most fodders contain all the ash needed by animals, but there are a few cases in which the exclusive use of one fodder only in the diet may cause trouble. For example, both maize and rice meal are deficient in those particular constituents of the ash which are required for the formation of bone. Cases not infrequently arise of leg bones breaking in pigs fed on these foods only. The addition of a small proportion of bone ash, or of another food rich in ash, such as skim milk, linseed cake, or coconut cake, prevents such trouble arising.

Nutritive Ratio.—The importance of proteins in nutrition, and the impossibility of replacing them by any other nutrient, has already been insisted on. For this reason it is important to know the relative proportion of proteins in different foods, and this is expressed by the nutritive ratio which gives the relative proportions of proteins to carbohydrates and fats, or, in other words, the relative proportions of " flesh formers " and " heat formers " in the food. In calculating the ratio, it must be remembered that 1 lb. of fat produces as much heat or work in the body as about 2¼ lb. of carbohydrates—such as starch or sugar. The rule for the calculation of the

nutritive ratio of any food is to multiply the percentage of digestible fat by 2¼, add the product to the percentages of digestible carbohydrates and digestible fibre, and divide the total sum by the percentage of digestible proteins.

Referring back to the table on p. 680 the statement that the nutritive ratio of meadow hay is 1 : 8 means that, for every pound of digestible proteins present in the hay, there are 8 lb. of digestible fat, carbohydrates, and fibre, reckoned as above. The nutritive ratio required by animals varies from about 1 : 5 to about 1 : 10, according to circumstances, so that meadow hay is a fairly well-balanced food for most purposes. The nutritive ratios of the other fodders included in the list are very much wider, from which it follows that they should be supplemented by the purchase of foods rich in protein, that is to say, foods with narrow nutritive ratios. The table on p. 680 also shows that most home-grown fodders are bulky, containing either much fibre or much water, and that at the same time they are deficient in fat. Foods bought to supplement them should, therefore, be concentrated (that is to say, they should contain little fibre or water) and be fairly rich in fat. Cakes made from oilseed residues best answer these requirements.

It is highly desirable that everyone who has to direct the feeding of stock should grasp these ideas. A proper understanding of the term nutritive ratio will prevent feeders from falling into such common errors as feeding pigs on coconut cake, replacing linseed cake by maize, or thinking that sugar beet slices can replace oats for horse feed.

Food Units.—This is the last term which requires explanation. Having set out the principles on which foods should be bought it remains to decide how the value of purchased foods should be assessed. For this purpose it is necessary to understand the term food units. It has been pointed out above that digestible fats, carbohydrates and fibre all play the same part in the body, *i.e.*, the production of heat and work, and that for this purpose 1 lb. of fat is as good as 2¼ lb. of carbohydrates or digestible fibre. It is, therefore, easy to reduce all these to one common denominator by simply multiplying the percentage of digestible fat by 2¼ and adding the product to the sum of the digestible carbohydrates and fibre. In order to value on the unit system, however, it is necessary to reduce the proteins also to the same denominator. From the scientific point of view this cannot be done, for proteins are required for a special purpose which carbohydrates and fats cannot fulfil. From the money point of view, however,

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate prices per ton at the end of September.				Approximate prices per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya Bean Cake	1 : 1·1	122·3	9 0 0	9 5 0	8 17 6	8 15 0	1 5	1 6	1 5½	1 5
Decorticated Cotton Cake	1 : 1·3	126·3	—	11 2 6	—	10 5 0	—	1 9½	—	1 7½
Indian Linseed Cake	1 : 1·9	123·1	—	11 5 0	—	—	—	1 10	—	—
English Linseed Cake	1 : 2·0	120·1	11 12 6	12 10 0	11 5 0	11 17 6	1 11	2 1	1 10½	1 11½
Bombay Cotton Cake	1 : 2·4	65·3	—	7 15 0	7 17 6	8 2 6	—	2 4½	2 5	2 5¾
Egyptian Cotton Cake	1 : 2·0	71·9	8 2 6	8 5 0	8 2 6	8 7 6	2 3	2 3¼	2 3	2 3¾
Coconut Cake	1 : 3·8	102·6	8 2 6	8 10 0	—	8 10 0	1 7	1 8	—	1 8
Palm-nut Kernel Cake	1 : 4·0	83·5	—	7 5 0	6 15 0	7 10 0	—	1 9	1 7½	1 9¾
Ground-nut Cake	1 : 0·9	145·2	*9 5 0	8 0 0	—	9 0 0	1 3½	1 1½	—	1 3
English Beans	1 : 2·6	99·5	9 5 3	11 4 0	10 2 1	9 17 10	1 10½	3	2 0½	1 11¾
Chinese Beans	1 : 2·6	101·2	10 0 8	—	8 15 0	—	1 11¾	—	1 8¾	—
English Maple Peas	1 : 3·2	97·2	11 11 1	—	12 17 9	—	2 4½	—	2 7¾	—
English Dun Peas	1 : 3·2	97·2	10 13 4	—	12 4 5	—	2 2¾	—	2 6½	—
Calcutta White Peas	1 : 2·3	97·5	13 6 8	13 8 10	—	—	2 8¾	2 8¾	—	—
American Maize	1 : 11	93·8	8 8 0	9 15 1	—	—	1 9½	2 1	—	—
Argentine Maize	1 : 11	94·2	7 9 4	7 2 10	7 2 4	7 2 4	1 7¾	1 6¼	1 6¼	1 6¼
Maize Meal	1 : 13	86·5	8 2 6	8 2 6	6 5 0	8 2 6	1 10¾	1 10¾	1 5¾	1 10½
Maize Gluten Feed	1 : 3·3	121·6	8 0 0	—	—	8 7 6	1 4	—	—	1 4¾
Maize Germ Meal	1 : 8·4	99·2	8 1 3	8 5 0	8 15 0	8 10 0	1 7¾	1 8	1 9¼	1 8¾
English Feeding Barley	1 : 7·8	83·0	11 4 0	—	11 4 0	11 15 2	*2 8¼	—	2 8½	2 9¾
English Oats	1 : 7·9	75·4	10 0 0	9 6 8	9 10 0	9 10 0	2 8	2 5¾	2 6½	2 6¾
Argentine Oats	1 : 7·9	75·4	9 9 9	—	—	9 18 11	2 6¼	—	—	2 7¾
Malt Culms	1 : 3·6	69·9	6 0 0	6 15 0	5 5 0	6 10 0	1 8¾	1 11½	1 6	1 10¼
Brewers' Grains (dried)	1 : 3·4	84·5	6 17 6	—	6 10 0	7 0 0	1 7½	—	1 6½	1 8
Brewers' Grains (wet)	1 : 3·4	21·1	0 13 0	—	1 4 0	—	0 7½	—	1 1¾	—
Egyptian Rice Meal	1 : 10·3	78·7	7 10 0	—	6 10 0	—	1 10¾	—	1 7¾	—
Burmese Rice Meal	1 : 10·3	78·7	6 15 0	7 5 0	—	7 5 0	1 8½	1 10	—	1 10
Wheat Middlings	1 : 5·3	93·4	8 5 0	—	7 5 0	0 10 0	1 9¼	—	1 6½	2 0½
Wheat Sharps	1 : 5·3	86·3	8 0 0	—	9 0 0	8 15 0	1 10¼	—	2 1	2 0¼
Wheat Pollards	1 : 5·3	81·9	—	6 12 6	—	—	—	1 7½	—	—
Wheat Bran	1 : 5·3	77·5	6 12 6	6 2 6	6 0 0	6 5 0	1 8½	1 7	1 6¼	1 7¼
Wheat Bran (broad)	1 : 4·7	79·9	7 12 6	6 15 0	7 10 0	7 0 0	1 11	1 8½	1 10½	1 9
Feeding Treacle	—	60·0	7 15 0	8 7 6	—	—	2 7	2 9½	—	—
Linseed, Calcutta	1 : 5·4	153·5	14 16 2	—	—	—	1 11½	—	—	—
" Bombay	1 : 5·4	153·5	15 1 6	—	—	—	1 11½	—	—	—
" La Plata	1 : 5·4	153·5	13 15 11	13 14 7	13 17 4	—	1 9½	1 9½	1 9	—
Linseed Oil	—	250·0	26 12 6	28 0 0	23 10 0	—	2 1½	2 3	1 10½	—

* 2nd grade, £8 17s. 6d.; undecorticated, £7 17s. 6d.

as between buyer and seller, it is found that 1 lb. of protein usually costs about as much as 2½ lb. of carbohydrates, this relative value being such as to allow for the manurial value of the nitrogen which the protein contains. Adopting this relative value for protein, the number of food units per ton in a food can be reckoned, as between buyer and seller, by multiplying the percentages of digestible proteins and fats each by 2½ and adding the products to the percentages of digestible carbohydrates and fibre. The price per food unit is then found by dividing the price per ton by the number of food units reckoned as above. Great economy in buying can be effected by adopting the unit system of comparing prices. Every buyer of foods should recognise that what he wants is so many food units having a certain nutritive ratio, and not so many tons of food bearing a certain name.

The table on p. 684 gives the nutritive ratios of a number of feeding stuffs, and their prices at the four great markets of London, Liverpool, Hull and Bristol. From these, and the standard average composition of the feeding stuffs, the prices per food unit are calculated and given in the last four columns.

The following table gives in order the average prices per food unit at the four markets. From this it appears that considerable and irregular changes in price have occurred since last month. The most striking change is the decrease in price of English oats, which amounts to 6¾*d.* per food unit. The present price of 2*s.* 6½*d.* per food unit makes oats still

Average Prices per Food Unit.

	s.	d.		s.	d.
Brewers' grains (wet) ..	0	10¾	Linseed cake, Indian ..	1	10
Ground nut cake ..	1	2½	Beans, Chinese	1	10¼
Maize gluten feed ..	1	4¼	Maize, American ..	1	11¼
Soya bean cake.. ..	1	5½	Linseed, Calcutta ..	1	11¼
Maize, Argentine ..	1	6½	,, cake, English ..	1	11½
Brewers' grains (dried) ..	1	7¼	,, Bombay ..	1	11½
Wheat bran	1	7¼	Wheat Sharps	1	11¾
,, pollards	1	7½	Beans, English	2	0¼
Coconut cake	1	7¾	Linseed Oil	2	1
Maize germ meal ..	1	8½	Cotton cake, Egyptian ..	2	3¼
Decorticated cotton cake	1	8½	Peas, English dun ..	2	4¼
Palm-nut kernel cake ..	1	8¾	Cotton cake, Bombay ..	2	5
Malt culms	1	9	Peas, English maple ..	2	6
Maize meal	1	9¼	Oats, English	2	6½
Rice meal, Egyptian ..	1	9¼	,, Argentine	2	7
,, ,, Burmese ..	1	9½	Feeding treacle	2	8¼
Linseed, La Plata ..	1	9½	Peas, Calcutta white ..	2	8¾
Wheat middlings ..	1	9½	Barley, English feeding	2	8¾
,, bran (broad) ..	1	9¾			

almost the dearest food on the market. Maize meal and Argentine maize have again declined slightly in price, and cotton cake has become still dearer. Other changes are not of any particular interest. Several foods appear in the list for the first time, namely, linseed, linseed oil, and treacle. Linseed at present prices works out at about the same price per food unit as linseed cake. For most purposes it has no advantages over the cake, especially as it must be crushed before use, and the crushing of raw linseed on the farm is not a very simple matter. Linseed oil is about 3*d.* per unit dearer than linseed cake, and its use seems to have no special advantages. Feeding treacle is very dear indeed, but it may still be advisable to buy a little, even at the present price, where it is desired to increase the palatability of straw.

Rations.—As regards suggestions for rations for October there is little to add to what was written in these notes last month. A few alterations may, however, be suggested for horse keepers.

Horses getting a full ration of clover hay, which is rich in digestible proteins, work well on about 10 lb. of maize per head per day, which is a cheap ration at the present price of maize. This ration will keep them fit and in good work during the short days.

Mares in foal should be well fed without being allowed to get fat. Maize and similar foods do not contain enough protein to provide for the nutrition of the unborn foal. A mixture of oats, bran and dried grains in equal proportions may be used at the rate of about a stone per head per day, according to the size of the mare.

Foals will pay for good feeding this year, if ever. During this month they may be given per head per day 1 lb. of oats and 2 lb. of bran, which may be increased, as the winter progresses and the foals grow, to 2 lb. of oats and 3 lb. of bran. It may be thought extravagant to recommend oats, even now their price has begun to decline, but at the present prices of horses in-foal mares and foals deserve special treatment.

The Feeding of Acorns to Live Stock.

ACORNS are a valuable addition to the rations of various classes of live stock, more particularly pigs, but also sheep, goats and adult cattle.

The food value of acorns lies chiefly in the large quantities of digestible carbohydrates which they contain. On this account they would form a useful supplementary food to green fodder, and to such foods as are rich in protein, and

they could, to a certain extent, replace in the ration cereal and other foods rich in carbohydrates.

Fresh acorns should preferably be fed only to the classes of live stock above mentioned, in moderate quantities, along with other foods, and the change to the ration containing acorns should be effected gradually. It is not safe to feed fresh acorns in any considerable quantity to pregnant sows, dairy cows or young cattle. Where pigs are driven into woods they must be given green or other complementary food which will supply a sufficiency of phosphates and lime, necessary substances which are present in acorns in only small quantities. Special care must be taken to withhold cattle from pastures where unripe acorns have been blown down.

Drying the acorns improves the flavour and feeding value and reduces the risk of illness, and acorn meal, prepared by grinding the kernels after drying and then separating them from the cracked husk by sifting after roughly crushing, has a feeding value approximately equal to that of barley meal and oat meal. Care should be taken not to feed any mouldy acorns.

Two instances of the value of acorns as food for live stock have recently come to the Board's notice.

In the first, the acorns were fed whole to horses in part substitution for oats, and also to sheep. Throughout last winter 16 horses on the farm received ½ bush. of acorns and 1½ bush. of oats each per week, instead of 2 bush. of oats; the acorns proved a good food, and were used until trifolium feeding began. The acorns cost 10*d.* a bush. for gathering; the oats they replaced would have cost 4*s.* 6*d.* per bush., so that the saving was about 1*s.* 10*d.* per horse per week. The acorns were also fed to sheep at the rate of ½ pt. or a little more per sheep per day. In all, 700 bush. of acorns were fed to the horses and sheep.

In the second case, a farmer who last year had 200 bush. of acorns used them for feeding to 30 breeding ewes. The ewes received 1 bush. per day (say 1 qt. per head per day) until lambing approached, when the ration was reduced to ½ bush. per day (or 1 pt. per head per day). It was remarked by this farmer that the ewes throve well on the acorns, and left other food for them, and he was most glad to have had such a large quantity of useful food at a cost of only 6*d.* to 9*d.* per bush.

Note.—A Special Leaflet (No. 9) was issued last October dealing with *The Food Value of Acorns, Horse Chestnuts and Beech Mast*, and an article on the same subject, going into considerable detail, was published in this *Journal* for September, 1914.

THE following notes have been issued by the Board as Special Leaflet No. 44 :—

Preserving Green Maize.

Grass having been fairly plentiful, it is probable that less green maize than usual has been required to supplement autumn pastures. With a view, therefore, to avoiding waste of a valuable crop, it is desirable that means should be taken to preserve, for future use, any surplus that may be available.

Maize should not be allowed to stand after about the middle of October, otherwise there is grave risk of its being destroyed by frost. Wherever, therefore, facilities for ensilage are lacking (see Leaflet No. 9, *Ensilage*) an attempt should be made to convert maize into hay.

For this purpose maize should be cut with a scythe as close to the ground as possible. A short stubble will facilitate subsequent tillage operations. The maize should be allowed to dry in the swathe until the leaves are quite limp. This will take, usually, from 24 to 48 hours, depending upon the weather. If left too long it spoils rapidly. It is then made into sheaves of about 12 in. diameter. "Stooking" or "shocking" in the ordinary way is impracticable on account of the ease with which maize sheaves are blown down. The best plan is to set up a row of hurdles and arrange the sheaves as closely as possible on both sides, keeping them in position by means of a line of binder twine. After standing for about a fortnight or three weeks, the partially dried maize may be used instead of straw for the following purposes :—

(1) To cover potato clamps where the potatoes will be marketed before Christmas ;
(2) To cover mangold clamps ; and
(3) As a bottom littering in open pig and cattle yards.

In experiments conducted at Cambridge stacking has not been successful, whether in the open or under cover. Decay tends to develop about the bands, and stock refuse the fodder. Even as late as February and March the stalks contain much juice which has an acid taste.

In America maize is often left for several months, and sometimes throughout the winter, to cure in shocks in the field. Although, with such treatment, the maize inside the shock may remain bright and green, and free from mould, it is computed that the loss in nutritive value amounts, on the average, to at least 20 per cent. Even when the curing is completed under cover, there is a loss of not less than 10 per

cent. This loss falls chiefly on the sugars, which undergo fermentation in the stalks.

Further experiments in the drying of maize are necessary; for the present it is suggested that the sheaves, after preliminary drying in the field, should be built, one sheaf deep, round a hollow wooden framework, and protected from the weather, or they might be ranged along the sheltered sides of hay or corn stacks. Where labour is available, the leaves might be stripped from the standing crop, dried, chaffed and used in a mixture.

Bracken as Litter.

IN view of the present high cost of feeding stuffs it is necessary that as much as possible of their manurial value should be recovered in the dung. The fact that the ordinary supplies of potash are meanwhile cut off furnishes another reason for preserving manure, especially liquid manure, with great care; liquid manure is rich in potash. In districts, therefore, where straw is scarce, or where it can be profitably fed to stock, farmers and horse-keepers should use for litter any other suitable material that may be available at a reasonable cost. Bracken or "fern" is specially worthy of attention at the present time.

Bracken possesses considerable value as litter, and in many places it may be obtained for the cost of cutting and carting. Bracken harvested while still green usually contains as much phosphoric acid as straw, and much more nitrogen, but less potash. If exposed to rain throughout the winter a considerable loss of substance is likely to result, although bracken cut in April has been found, on analysis, to have a similar composition to straw.

Bracken possesses a considerable power of absorbing ammonia and urine. To secure the full absorptive effect, however, bracken must be very thoroughly trampled upon by stock.

Dung made from bracken may be expected to be equal in chemical composition to dung made from straw. On the other hand, it takes longer to decompose in the soil, the fibrous woody stems being only slowly attacked. It therefore opens up the soil more, and is for that reason likely to be more useful on a heavy clay than on a light sandy soil. Bracken should be cut and dried in autumn, but where this is impracticable it may be cut and carted during suitable weather throughout the winter months.

Supplies of Goose, Turkey, and Duck Quills.

THE attention of the Board has been directed to the effect which the war has had upon the supplies of goose, turkey and duck quills available in Great Britain for commercial purposes. The chief sources of supply in recent years were Austria and Germany, but since the outbreak of war these imports have ceased. The present supplies are inadequate for the needs of the manufacturer, and there is a steady demand for quills of good quality, which could be met to a large extent by the proper selection and marketing of home supplies. Large quantities of English and Irish quills were formerly used in manufacture and the Board desire to direct the attention of breeders and dealers in poultry to the possibility of obtaining a ready market for one of the by-products of their industry, and of assisting the manufacturer.

The following scale of prices affords a guide to the present value of suitably selected quills :—

Large Goose Quills, per cwt. ..	50*s*. to 60*s*.,	according to quality.
Small " " " ..	30*s*. " 40*s*.	" "
Large Turkey " " ..	50*s*. " 60*s*.	" "
" Duck " " ..	25*s*. " 30*s*.	" "

In selecting and preparing the quills for despatch they should be tied in bundles weighing about 8 oz. with the barrels all pointing in one direction. If possible they should, for the sake of convenience and economy in carriage, be collected by a responsible person so that they may be despatched in lots of not less than half a hundredweight.

The Board are prepared to give information as to firms who would be willing to purchase such consignments in cases where producers find difficulty in obtaining a market.

Eradication of Swine Fever.

A DEPARTMENTAL Committee was appointed on 11th April, 1910, by the President of the Board of Agriculture and Fisheries to enquire into the cause of the continued prevalence of swine fever in Great Britain, and to report whether it is practicable to adopt any further measures with a view to secure its speedy extirpation.

The first Interim Report [Cd. 5671, 2*d*.] of the Committee was presented on 8th May, 1911, and a summary will be found in this *Journal* for June, 1911, p. 235. The Committee's Second Interim Report [Cd. 7247, 4½*d*.] was presented on 26th January, 1914, and was summarised in this *Journal* for March, 1914, p. 1098.

The Final Report of the Committee [Cd. 8045, 8*d.*], dated 12th August, 1915, commences by considering an account of experiments carried out by Sir Stewart Stockman at the request of the Committee.

Methods of Spread of the Disease.—After consideration of the report on the experiments the Committee arrived at the following conclusions with regard to the spread of the disease:—

(1) That the manure of pigs suffering from swine fever is infective.

(2) That a period of fourteen days may be regarded as sufficient to bring about the disinfection of infective manure through natural causes.

(3) That rats are not, as has been suggested, pathological carriers of swine fever.

(4) That all the available evidence suggests that swine fever is not disseminated by external parasites.

(5) That while persons, vehicles, and animals which have been in contact with infected pigs or premises may carry infective material mechanically within the area of their movements, subject to the time-limit indicated above, the evidence leads the Committee to the conclusion that all wide dissemination of disease is due to the movement of infective pigs.

(6) That a pig may become infective in three days after it has itself contracted infection and before it has actually exhibited clinical symptoms of the disease, and a pig which has contracted the disease may continue to be infective for a variable period, the extent of which has not yet been fully ascertained, but which is often of considerable duration.

(7) That there would appear to be cases in which healthy pigs which have not been visibly affected by swine fever and which, on post mortem examination show no evidence of having suffered from swine fever, are infective and continue to be so for a considerable time.

The Committee state that while the experimental investigation of this matter is very difficult and the evidence in support of the existence of carriers is largely circumstantial, the possibility that the carrier pig exists cannot be lost sight of, especially in considering the practicability of extirpating swine fever.

Serum Treatment.—From Sir Stewart Stockman's experiments with regard to the use of serum treatment and vaccination as methods of combating swine fever, it appears to the Committee that treatment with serum is highly effective in saving the lives of pigs which are exposed to infection immediately after serum has been injected, if they are free from infection at the time of treatment. Serum has, however, no curative effect, and the results of its use as a protection are so far disappointing in the case of young sucking pigs.

Treatment with serum alone confers only a short period of immunity, but this can be converted into a prolonged immunity if the pigs treated with serum are allowed to come in contact with infection. This procedure constitutes what may be called a natural vaccination.

" Artificial vaccination " consists in the simultaneous application of serum injection with an infection produced by the administration of virus by feeding or by inoculation. Artificial vaccination appears to the Committee to be attended by greater risks of producing severe forms of swine fever than natural vaccination, and the actual inoculation of virus appears to be more dangerous than feeding with virus.

Special Swine Fever Procedure Areas.—The special procedure adopted in certain areas was considered by the Committee in its effects during 3½ years. This special procedure has been as follows : Upon the declaration of disease, all the swine upon the premises which have been subjected to the risk of infection are slaughtered ; contact swine on other premises are traced and slaughtered ; post mortem examinations are made, and, if the disease is found to exist, tracing and slaughter on the same lines is carried out in respect of these premises also ; in order to minimise the risk of the introduction of disease into these areas from other districts, the movement of swine—except from areas subject to similar procedure, or from Ireland—other than those marked for immediate slaughter, is limited to swine for exhibition or breeding purposes.

It appears to the Committee, in the special procedure areas in which swine fever had previously been brought to a low ebb, that this special procedure has been successful in keeping down the number of outbreaks of disease at a time when the number of outbreaks underwent a very large increase in other parts of Great Britain. The Committee state, however, that the results are not such as to indicate that swine fever can be eradicated by the procedure in these areas unless all pigs from other areas are excluded from them. The special procedure has been abandoned for the present.

General Conclusions.—The general conclusions of the Committee are that the continued prevalence of swine fever appears to be due principally to its highly contagious character, and the difficulty of its recognition by the pig owner in its early stages and in its milder forms.

To these causes must be added the difficulty of completely tracing the place of origin and the movement of pigs by which the disease has spread.

The extirpation of the disease is practicable only by such drastic measures of slaughter as would involve a prohibitive outlay, and by such severe restrictions on movement as would be fatal to the industry of pig keeping.

Present circumstances, therefore, do not encourage the view that the extirpation of swine fever can be speedily accomplished or that such an objective should continue to be made the governing idea of administrative policy.

This conclusion, however, does not exclude the possibility that new preventive methods may bring about a condition of affairs more favourable to the prospect of eradicating the disease, and the study of such methods is being actively pursued.

Recommendations.—In view of all the evidence laid before them the Committee recommend :—

(1) That the attempt to extirpate the disease by general slaughter should be abandoned for the present ;

(2) That the immediate object of future policy should be—

(*a*) To reduce mortality from the disease.

(*b*) To control the spread of the disease.

(3) That in order to reduce mortality, the use of protective serum without avoidable delay in infected herds should be encouraged by every possible means and in particular by facilitating the supply of serum.

(4) That the production of immune herds by simultaneous administration of serum and virus should be undertaken where pig owners so desire, on premises selected as suitable and under careful supervision and restrictions.

(5) That in order to control the spread of disease the isolation of infected premises should be maintained by restrictive regulations, but that such restrictions should allow of the introduction to infected premises of pigs to be treated immediately with serum.

(6) That careful consideration should be given in the light of further experience to the extent to which existing general restrictions on movement may be relaxed as the result of new measures.

(7) That in view of the experimental results above referred to the lapse of a short period of time may be relied upon for disinfection of premises, and should be regarded as preferable to chemical disinfection in the case of large quantities of manure and of premises not readily capable of being disinfected by artificial means.

While the Committee submit the above recommendations, based on the present state of knowledge, they are strongly impressed by the possibility of artificial vaccination as a method of combating swine fever.

They also recognise the advantages that might accrue from the discovery of a reliable diagnostic test for obscure cases and they therefore recommend that investigation into this and cognate matters should be actively continued.

Report on the Poultry Industry in Wales.

EARLY in the present year Mr. Edward Brown, F.L.S., was asked by the President of the Board of Agriculture and Fisheries to undertake an enquiry, on the spot, into the condition of the poultry industry in Wales. The enquiry was chiefly directed towards ascertaining (1) the quality and suitability of the stock, (2) the method of housing and management, (3) the prevalence of disease, and (4) the methods of marketing. The results of Mr. Brown's exhaustive investigations, together with his recommendations for the development and improvement of the industry, are given in a Report of some 56 pages, which is published as a Supplement (No. 14)* to the present issue of the *Journal.*

NOTES ON AGRICULTURAL CO-OPERATION.

Haddenham Cattle Insurance Club.

THIS Club was founded in 1888 at Haddenham, a rural village in Cambridgeshire. The preface to its rules is as follows :—

"Whereas it has from long experience been proved that the loss of stock, by accident or otherwise, has often been attended with great inconvenience to many persons we, being Stock owners of this Parish, have in consequence thereof formed ourselves into a Club for the purpose of raising a fund by a small monthly subscription in order to lessen such loss in future ; and have resolved upon the following Rules."

The Society insures both horses and cattle. Its operations embrace six parishes, and all stock-owners living within a radius of five miles are eligible for membership. Each of the eight villages situated within this area has separate representation on the Committee, which consists of 23 members. There are now altogether 122 members, mostly small holders, some of whom have risen from the position of labourers, a number of them being actual owners of the land they cultivate. Some oft hem have quite small holdings and own each only one cow or one horse.

A new member is not entitled to receive any benefit from the Society until he has been enrolled three months. The entrance fee for a horse is 2*s.*, for a cow 1*s.* 6*d.* The animals insured are not valued except when they fall ill or die, when the valuers, consisting generally of the members of Committee for the village concerned, inspect the animal and fix its value, which is paid in full to the owner, if the animal dies, but subject to a maximum of £10 for a cow and £15 for a horse. The Club meets monthly and each member is bound to pay a subscription at the rate of 4*d.* per month for a cow, and 6*d.* per month for a horse. The

* Price 4*d.* post free. It will be forwarded free to subscribers on written application.

rules say that "The Committee shall have power to make levy of 1*s*. per head of stock for every loss sustained by the Club, such levy to be increased (if found necessary at the next monthly meeting)." On several occasions in the Club's history an extra levy has been made. A foal can be entered on the Club night falling on or after the 24th June in each year and any calf can be entered when 4 months old. The Club does not pay compensation for an animal whose death has been caused by fire or lightning.

During the ten years ending 1913 there was an increase in the number of members from 121 to 122, in the number of horses insured from 194 to 240, and in the number of cattle insured from 153 to 187. On the average a member insures about 2 horses and 1·5 cows, the largest number of animals insured by any one member being 10 horses and 4 cattle. For the ten years the average number of horses insured has been 223, and the average number of cattle insured 171. The number of claims paid has averaged 10 horses and 4·3 cattle, so that the average death-rate per cent. per annum has been 4·5 for horses and 2·5 for cattle. The average amount paid on claims per annum has been £83 17*s*. for horses and £36 11*s*. for cattle. Thus the average amount paid per animal that died has been £8 8*s*. for a horse and £8 10*s*. for a cow, and the average loss on claims per animal insured has been per annum 7*s*. 6*d*. per horse and 4*s*. 3*d*. per cow. As the amount received in monthly contributions has been per annum only 6*s*. per horse and 4*s*. per cow, the income from this source has not been sufficient to cover the expenditure in payment on claims.

The only other expenditure the Society has had to meet has been the costs of management, which have been small, as the officers of the Society all render their services gratuitously; the Secretary, who is a retired farmer, being allowed to spend up to 8*d*. per member on clerical expenses. For the last 10 years the costs of management have averaged only £5 15*s*. per annum, equivalent to an average of 3½*d*. per animal insured—a very low rate. Including payment on claims the total expenditure has averaged £126 3*s*. per annum.

Besides the monthly subscriptions the Society has received some income from entrance fees, averaging £8 10*s*. per annum, and from the sale of carcasses, which are sold to a knacker at a contract price of 25*s*. each carcass of whatever kind. Including receipts from all sources, the total income has averaged £122 2*s*., and, as the total expenditure averaged £126 3*s*. there has been an average loss per annum of £4 1*s*. During the 10 years' period the net assets of the Society fell from about £102 to £61 9*s*. 6*d*. at the end of 1913, notwithstanding a special levy of £18 18*s*. made in 1910.

The best-managed Societies arrange so that, on the average, their income shall exceed their expenditure, the surplus going to build up a reserve fund, which not only secures the members against having to make special levies in bad years, but brings in a steady and growing income in interest, and after it has reached a satisfactory figure, enables the Society, without danger, to increase the benefits it offers to its members or to reduce the contributions required from them. This Haddenham Society has been on the whole well and economically managed, but has not been able to build up a reserve fund, simply because the insurance contributions it charges are not quite high enough to cover the actual losses.

In regard to cows, the actual average death-rate for the last 10 years has been 2·5 per cent. per annum, which is just about equal to the average of the experience of all the cow-insurance societies in England and Wales (2·6 per cent.). Under the plan adopted by this Society under which no more than £10 is paid on the death of any cow however valuable, the actual average amount paid has been £8 10*s.* per cow that died, equal to 4*s.* 3*d.* per cow insured. The monthly subscriptions paid for a cow amount to 4*s.* per annum, which is not quite enough to pay for the losses, though the deficiency is not serious.

In regard to horses, the actual average death-rate of the last 10 years has been 4·5 per cent.—not a high rate as compared with the experience of other societies which insure horses. The Society pays up to £15 on the death of an insured horse, and the actual average payment made on horses has been £8 8*s.*, equivalent to a rate of 7*s.* 6*d.* per horse insured per annum. As the monthly subscriptions paid for horses only amount to 6*s.* per annum, it is evident that the Society has lost money on the insurance of horses, and that the chief step required to place its finances on a satisfactory footing is to raise the rate of insurance contribution *payable on horses to at least 8s. a year, or 8d. a month, instead of 6d.* If this were done, the Society might hope to avoid the necessity of making special levies, but it could not expect to see its reserve increase at all rapidly ; and if it aims at this object, it would be wise, to judge from its 10 years' experience, to raise the insurance contributions on cows from 4*d.* to 5*d.* a month, and on horses from 6*d.* to 9*d.* a month. The rate for horses should be nearly double that for cows, because the Society may have to pay £15 for a horse, but not more than £10 for a cow, and still more because its experience shows that the average death-rate among the insured horses is 4·5 per cent. per annum against 2·5 per cent. for the insured cows.

The Society might do still better if it adopted the system under which the Coveney New Cattle Club has been able to build up a reserve *fund of £365. That is to say, it might agree to pay seven-eighths of* the value of any animal insured, up to a maximum of £35, and require the owner to pay 1½*d.* per £1 per qnarter on the value of the animal, unless it were a brood-mare, in which case he should pay 2½*d.* per £ per quarter.

OFFICIAL NOTICES AND CIRCULARS.

Autumn Cultivation.

THE *Board of Agriculture and Fisheries have been informed by* the Army Council that in view of the possible shortage of agricultural labour for the Autumn cultivations, furlough will be given at the discretion of the Military Authorities, and as circumstances may permit, to a limited number of soldiers of the New Armies and of the Territorial Force who have been accustomed to work farm horses.

The furlough granted to each soldier will last only for such number of days, not exceeding four weeks, as he is actually required for the work.

The employment of soldiers will be subject to the following conditions :—

1. That suitable labour cannot be obtained in the locality.

2. That the farmer will undertake to pay each soldier sent at his equest :—

(*a*) 4*s*. a day if the soldier provides his own board and lodging.

(*b*) 2*s*. 6*d*. a day if board and lodging is provided by the farmer.

The hours worked to be those customary in the district.

3. That the farmer will provide conveyance from and to the nearest ailway station.

The above rates to be inclusive of all allowances and to be paid vet or fine.

No charge will be made to the farmer for railway travelling xpenses.

Every endeavour will be made to ensure that the men released ave been accustomed to work farm horses, but no guarantee to this ffect can be given, and if a farmer wants his son or one of his former abourers efforts will be made to arrange accordingly.

Applications from farmers who desire to employ soldiers must be made as soon as possible to the Board of Trade Labour Exchanges, when the application will be transmitted to the Military Authorities. Forms for the purpose will be obtainable on and after the 15th instant rom the Local Labour Exchange, the address of which can be obtained rom the nearest Post Office.

Storage of Apples and Pears.

OWING to the necessary demand of the Military Authorities on the Railway Companies serving some of the fruit-growing districts, it may be found that they are unable to accept for transport the whole of the crop of apples and pears as picked. It may, therefore, be necessary for growers to store some part of their crop. In these circumstances the Board desire to direct the attention of growers to the following notes which have already been published in the Board's Special Leaflet No. 6.

The requirements for the proper storage of apples and pears are not the same. Apples require to be kept in a cool, rather moist place, where there is enough ventilation to prevent saturation. Pears require warm, dry surroundings, but even under the most favourable conditions they will not keep long.

A few days after apples are put in store they begin to sweat, and continue to do so for about three weeks. During this time there must be a free current of air round them which must not be too dry or they will begin to shrivel. After the sweating period is over this is not so important. For larger growers a shed or storehouse is required if no cool cellar is available, and in preparing a store the following points should be remembered :—

1. The fruit must be protected from frost, but subject to this precaution the temperature should be as low and equable as possible. A cave in a sand or chalk bank makes an excellent storehouse.
2. A moist atmosphere is necessary. The best kind of floor is the bare earth which can be damped occasionally.
3. Ventilation to prevent stagnant and heated air is necessary, especially during the sweating period.
4. Apples easily absorb flavours from their surroundings. They should not be put on new wooden shelves or on straw or on

hay, nor should any strong smelling vegetable or other material be kept in the same room. Shelves of slate, or old seasoned wood, may be used.

A useful apple store may be made by digging a large hole about 10 ft. wide and as long as is required. The depth should be about 2 ft. A wall one brick thick and about 4 ft. high should then be built on either side, and the earth that has been dug out heaped up outside the wall. A roof made of rough rafters and thickly covered with thatch should be built over the top, and shelves fitted inside on which the apples may be heaped. There should be a door at each end so arranged as to admit air and exclude light.

Apples should never be stored in an attic or top room of a house.

In cases where apples or pears are ripe or are intended for immediate consumption the grower should give the earliest possible notice of his intention to forward by rail, specifying the quantity to the goods agent at the station from which they propose to consign.

Importation of Cattle into Ireland.

THE Board desire to point out to live stock owners that the importation of cattle into Ireland can be effected only on the authority of, and subject to, the conditions of a Permit granted by the Department of Agriculture and Technical Instruction for Ireland, but that Department are prepared to consider applications for Permits in respect of animals proposed to be imported for breeding purposes or exhibition. Each application must be supported by such information regarding the proposed importation as the Department may require and by satisfactory evidence as to the health of the cattle concerned and of all other animals on the premises where the cattle are, or have recently been, located. Forms for the purpose of furnishing the necessary information and evidence may be obtained on application to the Secretary, Department of Agriculture and Technical Instruction for Ireland (Veterinary Branch), 50 & 51, Upper Mount Street, Dublin.

Intending importers should note that in the case of young calves, the importer will be required to make suitable arrangements for the care and feeding of the animals during the importation journey.

Applications for Permits to import cattle (or calves) recently exposed in any open fair or market will not be considered.

Issue of Special Leaflets.

THE purpose of the Board's Special Leaflets was explained in the note in this *Journal* for September, 1914, p. 566, and lists of those issued have been given from time to time. Since the last list given (August, 1915, p. 468) the following have been issued :—

Special Leaflet, No. 35. Transport of Agricultural Produce.
" " 36. Winter Oats.
" " 37. Economy in Food.
" " 38. Bracken as Litter.
" " 39. Potato Disease.
" " 40. Notes on Breaking up Grass Land.
" " 41. The Importance of Producing Cheese.
" " 44. Preserving Green Maize.

National Egg Collection for the Wounded.

THE Committee who are responsible for the National Egg Collection for the Wounded, make an earnest appeal to all who are interested in the welfare of the soldiers in our hospitals for assistance at the present time when they find it most difficult to supply the 300,000 eggs which are required weekly. Help may be given by organising a regular collection of new-laid eggs in districts where no provision for collection is made at present, or by collecting money for the purchase of eggs from people who are unable to make gifts in kind.

Eggs collected for this purpose should be despatched, carriage forward, to the Committee's Central Depot, National Egg Collection, Messrs. Harrods, Ltd., Trevor Square, London, S.W. Receipt books for eggs and collecting cards for cash may be obtained on application to Mr. F. Carl, 154, Fleet Street, London.

Calcium Carbide Residue for Liming.

WHERE the residues of calcium carbide (used in the production of acetylene) can be obtained free of cost or at a nominal price, the material should be worth using for liming purposes. The residues are chiefly slaked lime containing from 30 to 40 per cent. of water; the dry matter contains about 60 per cent. of quicklime, *i.e.*, about 50 per cent. of CaO. There is a small amount of magnesia present in the residues, together, usually, with small quantities of silicon, sulphur, iron, phosphorus and carbon, but not enough to render the residues generally unsuitable for agricultural purposes.

Drying the residues would facilitate carriage, but would at the same time add to the cost.

Use of Bracken as Litter.

IN certain districts where straw is scarce or where it may be profitably fed to stock, farmers and stock-owners should consider the possibility of using bracken for litter. A special leaflet, giving a short account of the use of bracken, has been issued by the Board of Agriculture and Fisheries, who will send a copy to any applicant on receipt of an unstamped postcard addressed to them at Whitehall Place, London, S.W.

Potato Disease.

THE following notice was issued to the Press on 16th September:—

Favoured by moist weather in August, potato disease (*Phytophthora infestans*), has destroyed the haulm of potato crops in many parts of the country. The dead haulm, if allowed to lie on the soil, may infect the tubers. In view, however, of the drier weather of the past few weeks it is probable that as yet relatively few tubers have been attacked, and, consequently, that the immediate removal of diseased haulm would minimise risk of infection. As a further precaution, however, all crops should be lifted as soon as possible and carefully stored.

Further particulars of this disease, with suggestions as to storage of the crop, will be found in Special Leaflet No. 39 (Potato Disease), to be had, gratis and post free, on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, S.W.

Regulations under National Insurance Act, 1911.

THE National Insurance Commissioners have recently issued further regulations (Statutory Rules and Orders, 1915, No. 426, price 1*d.*) as to the classes of employment to be considered as employment within the meaning of Part I. of the principal Act. These regulations, so far as they concern employment connected with agriculture, provide as follows :—

Flower-pullers, fruit-pickers, hop-pickers, onion-peelers, pea-pickers, and potato-pickers on an agricultural holding are to be considered as employed within the meaning of Part I. of the principal Act only if at the time of entering upon the employment they were already insured persons, or were holders of certificates of exemption granted in pursuance of Sub-section (3) of Section 81 of the principal Act (referring to Irish migratory labour).

Hop-tyers on an agricultural holding are not to be considered as so employed.

Milkers are not to be considered as so employed unless they are otherwise ordinarily employed by the body or person to whom the service is rendered.

Report of the Chief Veterinary Officer for 1914.

THE Annual Report of the Chief Veterinary Officer of the Board for the year 1914 has been issued [Cd. 8.043, price 3*d.*]. The chief features of the Report are an account of the outbreaks of foot-and-mouth disease during the period, an estimate of the prevalence of swine tuberculosis and swine erysipelas, an article embodying the results of an investigation conducted at the laboratory in connection with Tropical and English red water and a report on the use of anti-abortion vaccine for epizootic abortion.

Parasitic Mange amongst Cast Army Horses.

THE Board have issued the following circular to Local Authorities in Great Britain under the Diseases of Animals Acts, 1894 to 1914 :—

SIR,—I am directed by the President of the Board of Agriculture and Fisheries to acquaint you, for the information of your Local Authority, that his attention has been drawn to certain cases of parasitic mange found amongst horses which had a short time previously been cast from the Army, and to the risk of the spread of the disease to other horses with which they were brought into contact.

Lord Selborne has been in communication on this subject with the Army Council, who have suggested that with a view of co-ordinating the efforts being made to control and eradicate the disease, Local Authorities might be asked to arrange that information as to cases of the disease found amongst cast Army horses should be at once reported direct to the General Officer Commanding the Command concerned in order that prompt investigation may be made, and steps taken to prevent further sale of any affected animals which may be discovered as the result of such investigation.

Lord Selborne desires me to request that your Local Authority will be so good as to make the arrangements suggested by the Army Council, and that such arrangements should apply not only to cases of parasitic mange, but also to the other equine diseases scheduled under the Diseases of Animals Acts, namely, glanders (including farcy), and epizootic lymphangitis.

The various commands and the area covered by each are shown in

Agricultural Returns for the United Kingdom.

THE preliminary statements of areas under crops and number of live stock on agricultural holdings as returned in June, 1915, issued by the Agricultural Departments for England and Wales, Scotland and Ireland, respectively, enable the following summary for the United Kingdom, with the comparative figures for 1914, to be compiled. The returns for the Channel Islands and the Isle of Man are not included.

—	1915.	1914.	Increase (+) or Decrease (—).	
	Acres.	*Acres.*	*Acres.*	*Per Cent.*
Wheat	**2,334,090**	1,904,930	+ 429,160	+22·5
Barley	**1,523,980**	1,871,170	— 347,190	—18·6
Oats	**4,148,050**	3,877,960	+ 270,090	+ 7·0
Potatoes	**1,202,520**	1,197,010	+ 5,510	+ 0·5
Turnips and Swedes ..	**1,617,460**	1,752,570	— 135,110	— 7·7
Mangolds	**500,490**	515,860	— 15,370	— 3·0
Clover, Sainfoin, &c., for hay	**2,839,920**	2,902,900	— 62,980	— 2·2
Permanent Grass for hay	**6,420,360**	6,489,880	— 69,520	— 1·1
	Number.	*Number.*	*Number.*	
Horses used for Agricultural Purposes (including mares kept for breeding) ..	**1,214,290**	1,320,470	— 106,180	— 8·0
Unbroken Horses (including Stallions). One year old and above..	**318,870**	350,360	— 31,490	— 9·0
Unbroken Horses (including Stallions). Under one year	**166,480**	171,730	— 5,250	— 3·1
Total	**1,699,640**	1,842,560	— 142,920	— 7·8
Cows and Heifers in milk or in calf	**4,476,470**	4,576,850	— 100,380	— 2·2
Other Cattle Two years old and above..	**2,217,760**	2,326,580	— 108,820	— 4·7
Other Cattle One year old and under two ..	**2,655,570**	2,587,850	+ 67,720	+ 2·6
Other Cattle Under one year	**2,781,570**	2,653,280	+ 128,290	+ 4·8
Total Cattle ..	**12,131,370**	12,144,560	— 13,190	— 0·1
Ewes kept for breeding ..	**11,304,730**	*11,221,600*	+ 83,130	+ 0·7
Other Sheep One year old and above..	**5,390,930**	5,037,910	+ 353,020	+ 7·0
Other Sheep Under one year	**11,485,880**	11,626,580	— 140,700	— 1·2
Total Sheep ..	**28,181,540**	27,886,090	+ 295,450	+ 1·1
Sows kept for breeding ..	**437,810**	492,980	— 55,170	—11·2
Other Pigs	**3,345,970**	3,446,910	— 100,940	— 2·9
Total Pigs	**3,783,780**	3,939,890	— 156,110	— 4·0

Food Supply and the Slaughter of Pigs.

IN view of the need for husbanding the food supply of the country, the Board of Agriculture and Fisheries decided last August that the slaughter of pigs for the purpose merely of reducing the risk of the spread of swine fever should be resorted to as little as possible, and that the slaughter of breeding sows or partially matured animals purely as a matter of precaution should be avoided. The Board have therefore relied on isolation combined with the slaughter of all swine distinctly sick of swine fever at the time of diagnosis.

Meanwhile, investigations into the efficacy of the injection of anti-swine-fever serum which were being carried out before the war began have been continued, and the results obtained, together with the evidence accumulated as to its use in other countries, show that if proper precautions are taken immunity from Swine Fever can be established by serum treatment.

The Board are now in a position to offer serum treatment of pigs *free of cost,* in the early stages of an outbreak of swine fever, and they* wish to impress on all owners that to obtain the best results from this treatment *notification of the suspected existence of swine fever on* their premises should be made at the earliest possible date. Any delay in notifying not only renders the owner liable to prosecution for failing to comply with the provisions of Article 1 (1) of the Swine Fever Order of 1908, but also tends to increase his loss owing to more pigs becoming affected before serum treatment is carried out.

Sampling and Analysis *of Feeding Stuffs.*

THE President of the Board of Agriculture and Fisheries desires to call the attention of agriculturists to the facilities afforded by Local Authorities, under the Fertilisers and Feeding Stuffs Act, 1906, for the sampling and analysis of feeding stuffs purchased for the use of stock. The effect of the European war on the *prices and supplies of feeding stuffs and the shortage of skilled labour* may result in mistakes and mis-descriptions of these materials on the *part of sellers. It is, therefore, very desirable that buyers should avail* themselves of the safeguards provided by the Act; whereby a purchaser may have a sample taken and submitted for analysis to the Agricultural Analyst by the Official Sampler appointed by the Local Authority. A small fee is charged by the Local Authority for these services. In order that proceedings may be instituted against the seller in the event of the analysis disclosing an offence under the Act, the sample should be taken within 10 days of the receipt of the goods or the invoice—whichever is the later—and after three clear days' notice to the seller of the intention to take the sample.

Scheme for the Appointment of War Agricultural Committees.

THE following scheme for the appointment of War Agricultural Committees has been published by the Board:—

County Committees.—Each county council shall appoint a War Agricultural Committee for the county.

The committee may consist either of *an existing committee or sub-committee* of the council with co-opted members or *it may be constituted for this special purpose. In any event it will* have no statutory basis. Whatever be the method of formation

adopted the committee should be fully representative of all the agricultural interests of the county, whether landowners, farmers, labourers, and others. In those counties where committees have already been established to deal with the organisation of farm labour it will obviously be desirable to co-ordinate their work with that of the War Agricultural Committee, and it is very important that the committee should include representatives of the Chamber of Agriculture, the Farmers' Union, and other agricultural societies or institutions in the county.

One of the existing officials of the county council, should, if possible, be nominated to act as clerk to the committee, and it is hoped that so far as their other duties permit the other members of the administrative staff of the council will be allowed to give the committee such help as they can.

The Board of Agriculture and Fisheries will nominate one of their commissioners or inspectors to act as their local representative for the purpose of the scheme, and it is hoped that he will be invited to attend the meetings of the committee.

District Sub-Committees.—The county council or the War Agricultural Committee when formed shall appoint a local committee for the area of each rural district in the county, and of each urban district which contains any considerable amount of agricultural land, to be composed of persons representing the various agricultural and horticultural interests of the district.

In most cases the utility of the local committee will depend upon the choice of its chairman and its clerk.

Functions of the Committee.—The principal functions of the committees will be as follows :—

1. To organise the supply of agricultural labour within the county.

The Board will arrange for the supply to each county committee of the information available under the National Registration Act as to the number of agricultural labourers in each rural or urban district in the county. The county committee should then ask the sub-committees to consider and report whether the supply of agricultural labour in the district is adequate, and if not, as to the extent of the deficiency. These reports should be considered by the county committees in consultation with the labour exchange officials with a view to meeting any deficiency as it arises by promoting co-operation in the use of labour, by the transfer of labour from another district, and by the employment of women or otherwise. County committees may well devote particular attention to the possibility of training women, and encouraging them to engage in agricultural work on the lines that have been successfully adopted by certain county and provincial councils.

2. To consider how the production of food in the county can be maintained, and, if possible, increased, always acting in close co-operation with the landowners, farmers, labourers and the members of the rural community.

The Board will supply to each county committee figures showing the acreage under the various crops and grass in each petty sessional division at the present time and in earlier years, which will be a guide to the extent to which an increase in the area under arable cultivation may be practicable.

The county committee should endeavour, through the agency of the local committees, to promote an increased production of those crops or stock which can be produced to the best advantage in the various districts, and will be to the greatest advantage to the State

during the war. The principal need at present is an increased production of wheat, oats, potatoes, meat, milk, cheese and bacon. The Provincial Advisory Council for Agricultural Education should be consulted as to the best means of enabling the services of the staff of the agricultural college or research institution of the province to be made use of in aid of the purposes of the schemes, and the committees should endeavour to persuade farmers to avail themselves of such services. Members of public bodies, such as the Chamber of Agriculture, the Farmers' Union, local agricultural societies, and the agricultural organisers and instructors of the counties should also be employed to advise as to the best and most profitable use of land.

Efforts should be made to stimulate increased food production by villagers as well as by farmers. Cottagers and allotment holders should be encouraged to live on the produce from their gardens and allotments as much as possible, and to increase their production of potatoes, vegetables, pigs and poultry.

3. To obtain information as to the requirements and supply available of (a) agricultural implements and machinery, and (b) fertilisers and feeding stuffs, and to report to the Board any deficiencies in these respects, or in the facilities for obtaining delivery, and also to encourage and promote co-operation amongst farmers for the procuring of supplies and machinery and for mutual assistance in the case of the latter.

4. Generally to assist and advise landowners, farmers and labourers in the county, and to inform the Board of any special difficulties which may come to their notice.

MISCELLANEOUS NOTES.

The Prevalence of *Tuberculosis* Among Pigs.*

DURING recent years the frequency with which tuberculosis has been found among swine, which were suspected by their owners of being affected with swine fever (and consequently reported to the Board under the swine fever order of 1908) has created the impression in the minds of the Board's veterinary officers that tuberculosis in swine is increasing. A record of such cases has been kept by the Veterinary Department during the past year—1914—and will be kept for a series of years.

Tuberculosis was diagnosed on 633 different premises on which were kept 8,632 swine of all ages. Of these, 989 were found to be affected with this disease—11·4 per cent. It must be borne in mind that this 11·4 per cent. probably does not represent the total number of swine affected, as it is only the proportion found to be affected at the time of the report to the Board. The average number of swine kept on these premises was 13·6, of which on an average 1·3 pigs were returned as affected.

As tuberculosis in swine is not a notifiable disease, owners are under no obligation to inform the Board of the presence of the disease in their herds. No reliable figures are, therefore, available showing the full extent of the disease in Great Britain. A further estimate of the extent of the disease may be formed, however, by consulting the Reports of the veterinary officers attached to large city abattoirs, as Glasgow or Birmingham.

* Report of the Chief Veterinary Officer for 1914 [Cd. 8043, price 3d.].

In Glasgow, 35,793 pigs were slaughtered during 1914, and of these, 1,986 were found to be tubercular; while, in Birmingham, 91,397 swine were slaughtered, and of these, 2,408 were tubercular: that is, 3·5 per cent. of all pigs slaughtered in the two cities were found to be affected.

If, then, 3·5 per cent. of all swine slaughtered in such cities as Glasgow and Birmingham, where meat inspection is highly organised, are tuberculous, it is fair to assume that even a higher percentage would be found affected in cities where the inspection is not so thorough, for it is well known that owners of doubtful carcasses avoid sending them to markets where the inspection is strict.

Great Britain usually carries a stock of about 2½ million swine, the great majority of which are eventually slaughtered for food. If we accept that even 3 per cent. of these are affected with tuberculosis, it will be realised that the prevention of tuberculosis in swine is a subject well worth the attention of agriculturists.

The following table shows the percentage of the different classes of swine found to be affected.

Description.	Number of pigs found on premises.	Affected.	Percentage Affected.
Boars	82	20	19·6
Sows	913	150	14·1
Unweaned	1,395	47	3·2
Fatting	1,841	178	8·8
Stores	4,401	594	11·9

The 3·2 per cent. of unweaned pigs found infected probably received infection from their dams, and it is important to be able to state in this connection that the post-mortem reports on many infected sows contained references to the existence of mammary lesions.

It is also probable that some of the stores found affected received the infection from their dams, and were not noticed to be ill until they were weaned.

According to our present knowledge, the tuberculosis which affects pigs can be referred mainly to two types, bovine and avian, the former being the more common. This important question in relation to infection is now receiving attention at the Board's veterinary laboratory.

The fact that 11·9 per cent. stores were found affected, as compared with 3·2 per cent. unweaned pigs, however, rather supports the view that the infection in swine is mainly of bovine origin, and that it is acquired after weaning, for it is not until pigs are weaned that they become infected by feeding on tuberculous cow's milk, milk offals, and other offals of animal origin.

An important fact brought out by the table is that the higher percentage of infection was found in the older animals, that is to say, those which had been exposed longest to the risk of infection.

Tuberculosis, however, is, as a rule, a slowly progressive disease, and as the life of the majority of swine is a matter of months rather than years, a number, although infected in early life, will, if properly housed, and fed, fatten sufficiently to allow them to be marketed before symptoms of the disease are noticed by their owners. On the other

hand, breeding stock being allowed to live longer, the disease has more time to progress, and a greater proportion is found to be badly affected than among the shorter living classes of swine.

While it is generally held that tuberculosis of swine is primarily of bovine origin, infected sows, especially if their udders are affected, are a serious source of infection to their progeny.

Boars are usually housed separately from other pigs, but, if they are infected, they cannot be disregarded as sources of infection, for their dung is often thrown on to a dunghill to which the store pigs have access.

It may be concluded that a herd of swine in which about 10 per cent. are affected cannot be profitable. This point of view, unfortunately, is not fully brought home to those who breed stores for sale or to those who fatten them quickly for slaughter, because the loss frequently falls upon a middleman. The loss from a national point of view, however, is undeniable, and it ought not to be too much to expect pig breeders and feeders to act from this standpoint. Tuberculosis, its symptoms, and prevention are dealt with in Leaflet No. 277, and it is unnecessary to go into the matter here, except to repeat that tuberculosis of swine is preventable by measures which are within the power of every breeder and feeder to take.

Annual Report on the Administration of the Grant for the Improvement of the Live Stock Breeding Industry.

PARTICULARS of the Board's scheme for the encouragement and improvement of the live stock breeding industry were given in this *Journal* for April, 1915, p. 46. The first Report of the Board on the administration of the scheme during the twelve months, 1st April, 1914, to 31st March, 1915, has recently been published [Cd. 8017, price 3½*d*.].

The total amount of financial assistance which the Board were authorised to give during the year was as follows :—

	£
Grants to societies or individuals for the provision of bulls	13,700
,, ,, societies for the provision of boars ..	1,200
,, ,, heavy horse societies	9,100
,, ,, milk-recording societies	4,600
,, ,, the selected agricultural institutions for the employment of live stock officers ..	8,400
	£37,000

The grant has been divided by the Board between England and Wales in proportion to the estimated numbers of holdings above 20 and not exceeding 100 acres—namely 81 and 19 per cent. to each country respectively—and they have apportioned the amount available between the twelve provinces into which the country has been divided for the purposes of agricultural education in accordance with the distribution of animals between these districts. The allocation of the amounts to each county was made on the same principle and in accordance with local needs.

The advisory work in connection with the scheme is carried out by the live stock committees of the advisory councils which have been set up in the above-mentioned provinces. In addition to these advisory bodies, a committee has been constituted in every county in which

the live stock scheme is in operation to assist the live stock officer (appointed in each province) to administer the grants. Many of the leading breeders and farmers of the country have been good enough to accept the invitation of the Board to serve on these committees, and their active co-operation and assistance should prove of great value.

The procedure as to the award of grants is briefly as follows: (1) The Board inform a provincial committee of the amount of grant available for their province; (2) the provincial committee allocate the amount between the counties within the province; (3) the county committee, in consultation with the live stock officer, recommend to the Board, for award of grants, those applications of which they approve; (4) the grants are made by the Board direct to the society or individual recommended.

Progress.—The live stock scheme may be considered to have been well received, and it has been well taken up in those districts in which live stock officers have been at work for some time in promoting it. Since its inception, 497 bulls and 115 boars have been located for service, grants have been made in respect of 72 stallions, and 16 milk-recording societies have been formed and have started operations.

Of the 497 bulls 454 were provided by societies and 43 by individuals; the average price paid was £36 (although some animals were purchased at notably higher figures), and the service fee varied from 5*s.* to 2*s.* 6*d.* In very many cases these animals have taken the place of mongrel sires, costing anything from £10 to £20. Only 83 of the 454 societies' bulls were purchased, the remaining 371 being provided by arrangement with the owners of the animals.

The average price paid for the 115 boars was £7, and, as in the case of bulls, these boars are reported to be taking the place of inferior sires. As a result of the condition that only pedigree boars are eligible for grants, steps were taken to establish a herd-book for "Gloucester Old Spots."

The 72 stallions were hired by 65 societies, 39 of which were new, and in all probability would not have come into existence had not the live stock scheme been started. The hiring fees averaged £231, with a service fee of £2 8*s.* 6*d.* The number of mares served averaged 90 per stallion, of which 68 were covered at the full fee and 22 at half fee.

With regard to the 16 milk-recording societies formed, the number of cows of which records are being taken is approximately 7,500. Considerable difficulty has been experienced in securing the support and interest of farmers in this part of the live stock scheme, but when the abnormal conditions that prevail are taken into account the results of the first year of operations may be regarded as being not altogether unsatisfactory.

In general, the live stock scheme has been taken up with more enthusiasm in some parts of the country than in others, but if continued for a sufficient number of years, it must bring about a marked improvement of the live stock of those farmers and small-holders who take advantage of it.

Notwithstanding the difficulties that have arisen in some districts owing to local conditions or prejudices, the live-stock officers have been able to report that good work has been done on the whole, and that when the scheme becomes more widely known a more general adoption of it will be assured.

Report of the *Education Branch,* 1914-15.

THE Annual Report of the Education Branch of the Board dealing with the distribution of grants for agricultural education and research in 1914-15 has been recently issued [Cd. 8066, price 8½*d.*]. During the year new regulations governing the distribution of grants for agricultural education and research were drafted (see this *Journal* for April, 1915, p. 65), and an account is given in the report under notice of the purposes for which they were introduced.

Full reports on the work of the Research Institutes established under the Board's Development Schemes are published, of which those relating to the Rothamsted Station, the Plant-breeding Institute at Cambridge, and the Fruit Research Institute at Bristol are of special interest.

The aggregate grants for Agricultural Education in the financial year 1914-15 were £95,410 as against £67,939 in the preceding year.

The report also gives an account of the war measures taken by the Education Branch since August of last year. On the outbreak of war a circular letter was addressed to the agricultural colleges in which it was pointed out that it was desirable that they should be prepared to advise on methods of economising crops then just harvested, and on possible alterations in the cropping of the succeeding season.

One of the first matters to attract attention was the need for augmenting the supply of home-grown foods. The steps taken to provide instruction on this subject by means of special leaflets have been noted from time to time in this *Journal*. Twenty-seven special war leaflets were issued during the year, and of these upwards of one million copies were distributed.

A grant of £60 was paid to Armstrong College in connection with the cultivation of allotment gardens in Cumberland and Westmorland by workers. Landowners agreed to provide land free of rent, and a committee, formed by prominent agriculturists, members of local authorities, manufacturers and others in the two counties, supplied seedling plants and technical advice through county instructors and the Armstrong College. The operations were highly successful, and resulted in a large increase in vegetable culture.

Another matter which pressed itself on attention early in the autumn of last year was the need for extending the important industries of fruit preserving and vegetable drying in this country. The latter industry was almost wholly in German hands before the war and, mainly in the case of potato drying, was indirectly aided by the State.

A scheme for the employment of women in fruit and vegetable preserving was set on foot by the Central Committee for Women's Employment and Dr. Lillias Hamilton, of Studley Horticultural College for Women, in order to provide employment for women thrown out of work by the war. As there seemed to be some prospect of developing a new local industry, the work was taken over by the Board and placed under the supervision of a representative Committee. A grant-in-aid of the work was made from the Development Fund.

For the purpose of financing these and similar schemes, a special emergency grant has been sanctioned by the Treasury from the Development Fund. The aggregate payments from this grant during the year were distributed as follows: Fruit and vegetable drying, £492; winter egg production, £71; home food culture committee

for Cumberland and Westmorland, £61; and enquiry into poultry industry in Wales, £45; total, £669.

Early in the present year the shortage of milkers all over the country suggested to the Board the advisability of instituting an experimental scheme for training women in milking. The agricultural colleges and established farm schools were, accordingly, approached with a suggestion that, if they would give facilities, the Board were prepared to provide a limited number of scholarships for the purpose. Many of these institutions accepted the scheme, and, with the aid of the Labour Exchange Department of the Board of Trade, a considerable number of women have been given short courses of instruction in milking and other suitable farm occupations. Numbers of these women have succeeded in obtaining employment, and the object of the Board—the demonstration of the possibility of training suitable women in a very short time for work of this kind—may be claimed to have been attained.

Notes on Crop Prospects Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for September, 1915, issued by the International Institute of Agriculture, contains estimates of the production of cereal crops this year. The countries comprised in the approximate estimate of the production are as follows:—In *Europe*—Bulgaria, Denmark, Spain, France (not including the invaded regions), Great Britain, Ireland, Italy, Luxemburg, Netherlands, Rumania, Russia in Europe (54 governments), Switzerland; in *America*—Canada, United States; in *Asia*—India, Japan, Russia in Asia (10 governments in 1914-15 and 9 governments in 1913-14); in *Africa*—Egypt, Tunis.

Wheat.—The total production in the above-mentioned countries is estimated to amount to 431,956,000 qr. in 1914-15, against 362,558,000 qr. in 1913-14, or an increase of 19·1 per cent.

Rye.—In the specified countries, excluding Great Britain, India, Japan, Egypt, and Tunis, the estimated production is placed at 132,925,000 qr. this year, as compared with 115,256,000 qr. last year, the increase being equal to 15·3 per cent.

Barley.—For the above-mentioned countries, excluding Luxemburg and India, the total production is estimated at 138,793,000 qr. in 1914-15, against 118,350,000 qr. in 1913-14, or an increase of 17·3 per cent.

Oats.—For the same countries as above, excluding Luxemburg, India, Japan, and Egypt, the production is placed at 375,597,000 qr. this year, against 312,400,000 qr. last year, or an increase of 20·2 per cent.

Maize.—The production in Italy, Rumania, Russia in Europe (54 governments), Switzerland, United States, Japan, and Russia in Asia (10 governments in 1915, and 9 governments in 1914), is estimated at 383,995,000 qr. in 1915, or an increase of 10·8 per cent. compared with 1914, when the production amounted to 346,676,000 qr.

Live Stock in New Zealand.—The "Interim Return of Sheep in the Dominion on the 30th April, 1915," gives the number of sheep as 24,465,526, against 24,798,763 on the same date in 1914, or a decrease of 1·3 per cent. (*Bulletin of Agricultural and Commercial Statistics,* September, 1915.)

France.—The condition of the crops on the 1st September was officially estimated as follows:—Maize, 68 as compared with 74 on *the 1st August; potatoes, 53 against 62; and* linseed, 67 against 60. (80 = good. 60 = fairly good, and 50 = passable). (*The London Grain, Seed and Oil Reporter*, 27th September.)

According to the preliminary official estimates of the grain crops, the areas sown (exclusive of the territory occupied by the enemy) are as follows (acres):—Wheat, 14,058,600; rye, 2,544,000; oats, 8,447,000; and barley, 1,711,000. The total production of wheat is estimated at 29,700,000 qr. as compared with 39,200,000 qr. for the whole country last year; rye, 4,550,000 qr. against 6,000,000 qr.; oats, 27,200,000 qr. against 36,000,000 qr.; and barley, 4,330,000 qr. against 5,800,000 qr. —(*The London Grain, Seed and Oil Reporter*, 1st October.)

Holland.—H.B.M. Consul-General at Rotterdam in a report, dated 13th September, on the condition of the crops, stated that beans were, on the whole, good to very good, and peas were moderate to fairly good in the south of the country and in North Brabant and Gelderland, but good elsewhere. Mustard seed was good everywhere. Prospects for potatoes were rather unsatisfactory, and, on the whole, the yield will be less than last year. The condition of sugar-beet was fairly good to good, while onions were fairly good in North Holland, and good elsewhere. Chicory was fairly good to good generally.

Rumania.—The total production of the crops is officially estimated as follows:—Wheat, 13,600,000 qr., as compared with 5,800,000 qr. last year; maize, 12,800,000 qr., against 12,600,000 qr.; barley, 2,840,000 qr., against 12,800,000 qr.; oats, 2,750,000 qr., against 2,500,000 qr.; and rye, 360,000 qr., as compared with 210,000 qr. (*The London Grain, Seed and Oil Reporter*, 9th September.)

Russia.—According to the preliminary estimate published by the Central Statistical Committee, the *area* under the principal crops in 64 governments is as follows (acres):—Winter wheat, 17,150,400 as compared with 17,165,520 in 1914; spring wheat, 56,185,110 against 58,745,250; barley, 29,751,030 against 31,068,900; oats, 44,791,920 against 46,929,240; rye, 69,031,710 against 69,525,000; and potatoes, 8,792,550 against 9,562,860. The estimated total *production* in 61 governments is as follows (quarters):—Winter wheat, 31,950,000 as compared with 26,175,000 in 1914, and 26,280,000, the average of the years 1909–13; spring wheat, 71,745,000 against 66,892,000 and 63,927,000 respectively; barley, 56,835,000 against 47,619,000 and 15,588,000 respectively; oats, 106,184,000 against 91,332,000 and 101,947,000 respectively; maize, 8,722,000 against 9,435,000 and 8,205,000 respectively; and rye, 100,148,000 against 93,742,000 and 93,404,000 respectively.—(*Broomhall's Corn Trade News*, 30th September.)

Canada.—According to a bulletin, dated 13th September, issued by the Census and Statistics Office at Ottawa, the total yield of wheat is estimated at 308,839,800 bush., as compared with 158,223,000 bush. last year; oats, 488,000,000 bush., against 311,426,000 bush.; barley, 51,655,000 bush., against 34,591,000 bush.; rye, 2,385,700 bush., against 2,258,000 bush.; and linseed, 12,199,600 bush., against 7,533,000 bush. (*The London Grain, Seed and Oil Reporter*, 18th September.)

United States.—The Crop Reporting Board of the Bureau of Statistics of the Department of Agriculture, in reporting as to crop conditions on the 1st October, states that the total production of winter wheat is estimated at 659,000,000 bush. as compared with a yield of

684,990,000 bush. last year; spring wheat at 345,000,000 bush. against 206,027,000 bush.; maize at 3,026,000,000 bush. against 2,672,804,000 bush.; oats at 1,517,000,000 bush. against 1,141,060,000 bush.; barley at 237,000,000 bush. against 194,953,000 bush.; and linseed at 18,000,000 bush. against 15,559,000 bush.—(*The London Grain, Seed and Oil Reporter*, 7th October.)

Australia.—The wheat crop of New South Wales is estimated by the Minister of Railways at 60,000,000 bush., as compared with 13,000,000 bush. last year, and 38,000,000 bush. in 1913. (*Broomhall's Corn Trade News*, 10th September.)

Hops.—*United States.*—His Majesty's Consul at Portland, Oregon, in a report, dated 31st August, stated that the hop crop in Oregon would not exceed 110,000 bales. Picking had begun, but many of the smaller yards, which had not been properly sprayed, were not fit to pick. According to a report, dated 27th August, prices were very low, being then only about 6*d.* per pound, and buyers were of opinion that the prices would be lower. About one-fourth of the hops had been sold.

Agricultural Conditions in England and Wales on 1st October.

THE reports furnished by the Crop Reporters of the Board on agricultural conditions in England and Wales, state that the weather of September, which was everywhere a very fine month, proved excellent for the completion of the harvest. The cereal crops were all secured in very good condition, though there is still some outstanding corn in the hilly districts. The dry weather arrested the progress of disease among the potatoes; and it is very frequently reported that the disease affected only the haulms without reaching the tubers. Most counties, however, mention its existence, although it appears to be little more prevalent than usual, except perhaps in Lancashire and some parts of the south-east of England. On the whole, the yield is expected to be about 1 per cent. below the normal.

Roots have been very generally kept back by the dry weather, accompanied in some districts by cold nights; while, owing to a certain scarcity of labour, hoeing has been frequently neglected. Turnips and swedes are consequently a poor crop, and unless good growing weather, with rain, should improve them, will probably be some 10 per cent. below average. Mangolds are better, but still they are expected, on the whole, to be some 4 per cent. below average.

A certain amount of autumn cultivation has been done, varying very much according to the locality. In many parts it is rather backward owing to the ground being too hard, and in other districts owing to the harvest having been rather late; on the whole, work is perhaps rather behindhand. In only very few instances is any wheat reported to have been sown by the end of September.

In the eastern counties roots and clovers grown for seed have very generally given poor results, especially the latter; and many farmers who had been intending to harvest clover seed have preferred to take a second crop of hay.

The young seeds are nearly everywhere healthy and vigorous, affording good prospects for next season: in only few cases are the fields patchy or otherwise unsatisfactory.

Pastures in some districts were getting rather bare at the end of the month, but generally there was plenty of keep. Live stock have done well generally.

Agricultural Labour in England and Wales during September.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st October, the supply of labour in England and Wales during September was everywhere more or less scarce, but the fine weather, by reducing the number of lost days, caused the deficiency to be less felt than would have been the case with a wet harvest. In many cases women helped in the fields, and the chief trouble was noticed in connection with turnip hoeing. In some districts some apprehension was felt as to the sufficiency of labour for autumn cultivation.

The following local summaries give further details regarding agricultural labour in the different districts of England and Wales :—

Northumberland, Durham, Cumberland, and Westmorland.—Labour was still scarce, but the fine weather enabled the harvest to be secured in good time.

Lancashire and Cheshire.—Labour was scarce, but generally the shortage was not felt acutely, the favourable weather enabling the harvest to be terminated with a minimum of difficulty.

Yorkshire.—Labour continued to be scarce, but owing to the fine weather the shortage did not materially hamper the harvesting of the corn crops.

Shropshire and Stafford.—Labour was reported everywhere to have been scarce, especially casual labour. In south-east Stafford potato lifters were wanted during the month, and difficulty was experienced in procuring good stock and team men.

Derby Nottingham, Leicester, and Rutland.—In nearly all districts labour, both skilled and casual, was very short. Nottingham appeared to have felt the deficiency less than other counties. The excellent weather mitigated to some extent the inconvenience caused by the shortage.

Lincoln and Norfolk.—The supply of labour was generally deficient, especially for threshing ; but, aided by the fine weather and mutual co-operation amongst farmers it proved just sufficient for harvest requirements. More serious difficulty, however, was anticipated in connection with autumn cultivation. In north-west Lincoln women were being extensively employed in lifting potatoes.

Suffolk, Cambridge, and Huntingdon.—Labour was still scarce, and women and boys were employed in many districts.

Bedford, Northampton, and Warwick.—Labour was generally scarce, the deficiency being most pronounced in Bedfordshire.

Buckingham, Oxford, and Berkshire.—The supply of labour was rather short, but, owing to the fine weather, the deficiency was not seriously felt.

Worcester, Hereford, and Gloucester.—There was a general and increasing shortage of labour, and in south-west Hereford threshing was said to have been much delayed thereby In some districts more use was being made of female labour.

Cornwall, Devon, and Somerset.—Labour was very scarce, but no great inconvenience was felt except in parts of Somerset. The weather was favourable for the completion of harvesting operations without extra labour.

Dorset, Wiltshire, and Hampshire.—The supply of labour was still short, but the favourable weather enabled the harvest to be secured with less difficulty than was expected.

Surrey, Kent, and Sussex.—The supply of labour continued to be short, but no great inconvenience was caused.

Essex, Hertford, and Middlesex.—The supply of labour was generally short, and in the south of Essex the root crops were suffering for want of hoeing.

North Wales.—On the whole, labour was scarce, but the shortage would not appear to have been seriously felt. The supply of labour in Anglesey, in south-west Carnarvon, and in west Merioneth generally proved sufficient for the demand.

Mid Wales.—The supply of labour was short in some districts, but generally proved sufficient for immediate requirements, as the fine weather considerably facilitated the harvesting operations of the month.

South Wales.—Labour, especially casual labour, was still very short, but the deficiency was not felt so much since the harvest was secured.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st October, 1915, certain diseases of animals existed in the countries specified:—

Austria (on the 1st Sept.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (month of July).
Anthrax, Foot-and-Mouth Disease (559 outbreaks), Swine Erysipelas, Swine Fever.

France (for the period 5th—18th Sept.).
Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Swine Fever.

Germany (for the period 15th—31st Aug.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (month of Aug.).
Anthrax, Foot-and-Mouth Disease (68 outbreaks), Foot-rot, Swine Erysipelas.

Hungary (on the 1st Sept.).
Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox, Swine Erysipelas, Swine Fever.

Italy (for the period 6th—12th Sept.).
Anthrax, Blackleg, Foot-and-Mouth Disease (2,455 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever.

Norway (month of Aug.).
Anthrax, Blackleg, Swine Fever.

Rumania (for the period 14th—21st Aug.).
Anthrax, Foot-and-Mouth Disease, Glanders and Farcy, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Russia (month of May).
Anthrax, Foot-and-Mouth Disease (272,019 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (*month of July*).
Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (*month of Aug.*).
Anthrax, Blackleg, Swine Erysipelas.

Switzerland (*for the period* 13*th*—19*th Sept.*).
Anthrax, Blackleg, Foot-and-Mouth Disease (16 "étables" entailing 655 animals, of which 2 "étables" were declared infected during the period), Swine Fever.

No further returns have been received in respect of the following countries :—Belgium, Bulgaria, Montenegro, Serbia.

The Weather in England during September.

District.	Temperature. Daily Mean.	Temperature. Diff. from Average.	Rainfall. Amount.		Rainfall. Diff. from Average.	Rainfall. No. of Days with Rain.	Bright Sunshine. Daily Mean.	Bright Sunshine. Diff. from Average.
Week ending Sep. 4th :	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours
England, N.E. ...	51·6	−5·1	0·81	21	+5	5	5·7	+1·0
England, E.	53·2	−5·3	0·60	15	+1	5	4·4	−1·1
Midland Counties ...	52·4	−5·0	0·31	8	−8	3	5·0	+0·2
England, S.E.... ...	54·5	−5·1	0·75	19	+2	4	4·8	−0·9
England, N.W. ...	51·9	−5·1	0·60	17	−6	3	6·5	+2·0
England, S.W. ...	53·8	−4·3	0·47	12	−11	4	6·0	+0·6
English Channel ...	56·4	−4·3	1·08	27	+10	4	7·2	+0·7
Week ending Sep. 11th :								
England, N.E.... ...	57·2	+1·3	0·02	1	−14	1	7·8	+3·0
England, E.	57·9	+0·2	0·01	0	−12	1	9·1	+3·7
Midland Counties ...	56·7	+0·2	0·00	0	−13	0	8·5	+3·8
England, S.E.... ...	57·1	−1·7	0·00	0	−14	0	10·2	+4·6
England, N.W. ...	58·3	+2·0	0·07	2	−16	1	7·8	+3·2
England, S.W. ...	57·0	−0·5	0·00	0	−18	0	9·3	+4·0
English Channel ...	60·6	+0·5	0·00	0	−14	0	10·8	+4·3
Week ending Sep. 18th :								
England, N.E. ...	59·3	+4·3	0·09	2	−10	1	4·7	0·0
England, E.	61·6	+4·8	0·04	1	−9	1	5·3	+0·1
Midland Counties ...	60·5	+4·8	0·08	2	−8	2	4·5	−0·1
England, S.E	61·9	+3·9	0·11	3	−8	2	5·9	+0·5
England, N.W. ...	59·8	+4·1	0·08	2	−12	2	4·7	+0·1
England, S.W. ...	60·5	+3·6	0·34	9	−5	4	4·7	−0·4
English Channel ...	63·1	+3·5	0·16	4	−8	2	6·2	−0·4
Week ending Sep. 25th :								
England, N.E. ...	56·5	+2·6	0·44	11	+2	2	3·8	−0·6
England, E.	58·8	+3·2	0·22	6	−5	2	5·5	+0·6
Midland Counties ...	56·8	+2·4	0·62	16	+5	2	4·6	−0·3
England, S.E.... ...	59·7	+2·9	0·82	21	+9	2	5·6	+0·6
England, N.W. ...	58·0	+3·4	0·39	10	−7	3	4·6	+0·4
England, S.W. ...	58·9	+3·0	0·38	10	−8	4	4·5	−0·2
English Channel ...	62·0	+3·2	0·84	21	+6	2	5·5	−0·6

* *1 inch = 25·4 millimetres.*

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	SEPTEMBER.		NINE MONTHS ENDED SEPTEMBER.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	24	39	442	557
Animals attacked	25	48	503	612
Foot-and-Mouth Disease:—				
Outbreaks	—	8	—	22
Animals attacked	—	17	—	108
Glanders (including Farcy):—				
Outbreaks	—	8	36	81
Animals attacked	1	30	66	249
Parasitic Mange:—				
Outbreaks	48	9	*628	1,530
Animals attacked	94	9	*1,354	2,642
Sheep-Scab:—				
Outbreaks	3	2	164	155
Swine Fever:—				
Outbreaks	170	336	3,163	3,157
Swine Slaughtered as diseased or exposed to infection ...	578	2,129	13,920	31,068

* Figures for six months only, the Parasitic Mange Order of 1911 having been *suspended from 6th August, 1914, to 27th March, 1915, inclusive.*

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	SEPTEMBER.		NINE MONTHS ENDED SEPTEMBER.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	—	—	1	1
Animals attacked	—	—	1	1
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	76
Animals attacked	—	—	—	957
Glanders (including Farcy):—				
Outbreaks	—	—	1	—
Animals attacked	—	—	3	—
Parasitic Mange:—				
Outbreaks	5	5	58	67
Sheep-Scab:—				
Outbreaks	25	17	315	407
Swine Fever:—				
Outbreaks	18	3	193	161
Swine Slaughtered as diseased or exposed to infection ...	100	23	1,100	842

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in September and August, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	September.		August.	
	First Quality.	Second Quality.	First Quality.	Second Quality.
FAT STOCK :—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle :—	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Polled Scots	12 4	11 4	13 4	12 3
Herefords	12 8	11 7	13 2	12 0
Shorthorns	12 7	11 6	13 3	12 2
Devons	12 9	11 9	13 4	12 5
Welsh Runts	12 5	11 9	13 3	12 7
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	*d.*	*d.*	*d.*
Veal Calves	10½	9½	10¾	9¾
Sheep :—				
Downs	11	10	11	10¼
Longwools	10¼	9½	10¼	9½
Cheviots	11¼	10¼	11	10
Blackfaced	10½	9¾	10¼	9¼
Welsh	10	9½	10½	9½
Cross-breds	11	10	11	10
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs :—	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Bacon Pigs	10 4	9 9	9 9	9 3
Porkers	10 9	10 3	10 2	9 9
LEAN STOCK :—	per head.	per head.	per head.	per head.
Milking Cows :—	£ *s.*	£ *s.*	£ *s.*	£ *s.*
Shorthorns—In Milk ...	27 5	22 10	26 17	22 2
,, —*Calvers* ...	25 13	21 7	25 7	21 5
Other Breeds—In Milk ...	25 3	19 16	24 4	19 17
,, —Calvers ...	20 0	18 10	19 5	17 17
Calves for Rearing	3 3	2 7	3 3	2 8
Store Cattle :—				
Shorthorns—Yearlings ...	13 17	11 17	13 17	11 15
,, —Two-year-olds...	20 6	17 10	19 6	16 19
,, —Three-year-olds	25 17	22 6	25 18	22 5
Herefords —Two-year-olds...	21 6	18 7	21 19	18 15
Devons— ,,	20 2	17 4	19 16	17 12
Welsh Runts— ,,	20 14	19 6	19 10	17 15
Store Sheep :—				
Hoggs, Hoggets, Tegs, and Lambs—	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Downs or Longwools ...	46 3	39 4	45 5	39 2
Store Pigs :—				
8 to 12 weeks old	28 11	23 3	28 1	22 2
12 to 16 weeks old	46 0	35 3	44 0	33 11

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in September, 1915.

(*Compiled from Reports received from the Board's Market Reporters.*)

Description.	Quality.	Birmingham.		Leeds.		Liverpool.		London.		Manchester.	
		per cwt.		per cwt.		per cwt.		per cwt.		per cwt.	
		s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
BEEF:—											
English	1st	84	0	80	6	—		84	6	81	6
	2nd	81	0	78	6	—		79	0	77	0
Cow and Bull	1st	77	0	75	0	73	6	74	0	73	6
	2nd	72	0	69	6	67	0	69	6	69	0
Irish: Port Killed	1st	83	0	79	6	81	6	82	0	79	6
	2nd	81	0	76	0	75	6	76	6	74	6
Argentine Frozen—											
Hind Quarters	1st	75	0	—		75	6	72	6	77	0
Fore ,, ...	1st	65	0	—		66	0	63	0	69	0
Argentine Chilled—											
Hind Quarters	1st	73	6	73	0	73	0	72	6	72	6
Fore ,, ...	1st	58	6	58	0	57	6	56	0	57	6
Australian Frozen—											
Hind Quarters	1st	73	6	74	6	73	0	71	0	73	6
Fore ,, ...	1st	64	0	69	0	66	6	64	0	66	6
VEAL:—											
British	1st	87	6	82	0	84	0	94	6	79	0
	2nd	80	6	77	6	74	6	85	0	72	0
Foreign...	1st	—		—		—		—		—	
MUTTON:—											
Scotch	1st	—		—		—		96	6	95	6
	2nd	—		—		—		91	6	91	6
English...	1st	88	6	91	0	84	0	90	6	90	6
	2nd	82	0	86	6	74	6	84	6	86	0
Irish: Port Killed	1st	86	6	—		82	6	87	0	88	6
	2nd	84	0	—		75	6	82	0	82	6
Argentine Frozen	1st	61	6	61	6	60	0	64	6	60	0
Australian ,, ...	1st	58	0	59	6	57	6	59	6	57	6
New Zealand ,, ...	1st	59	6	—		—		69	0	—	
LAMB:—											
British	1st	90	6	92	0	92	0	98	0	95	6
	2nd	87	6	87	0	82	6	90	0	91	0
New Zealand	1st	81	6	81	0	77	0	77	6	77	0
Australian	1st	74	6	70	0	72	6	73	6	72	6
Argentine	1st	74	0	69	6	73	0	72	0	73	6
PORK:—											
British	1st	91	6	86	0	88	6	97	6	87	0
	2nd	87	6	80	6	83	0	88	6	80	6
Foreign...	1st	—		—		—		—		—	

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in September, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Bristol.		Liverpool.		London.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	18 3	16 6	—	—	17 6	16 6
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	166 0	161 0	165 0	162 0	166 6	161 0
" Factory	142 0	135 6	141 6	136 0	149 0	139 0
Danish...	—	—	178 6	176 0	178 0	175 0
French...	—	—	—	—	152 0	146 0
Russian	143 0	135 0	138 6	136 0	139 6	133 6
Australian	—		—	—	—	—
New Zealand	—	—	—	—	—	—
Argentine	—	—	—	—	156 0	152 0
CHEESE:—						
British—						
Cheddar	89 0	77 0	93 0	89 6	91 0	84 6
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	86 6	82 0	89 0	81 6
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	79 0	75 0	79 6	75 0	77 0	74 0
BACON:—						
Irish (Green)	109 6	105 0	106 6	102 6	105 0	102 0
Canadian (Green sides)	96 0	83 6	94 6	85 0	95 0	90 0
HAMS:—						
York (Dried or Smoked)	122 0	118 0	—	—	125 6	120 0
Irish (Dried or Smoked)	—	—	—	—	124 6	118 6
American (Green) (long cut)	74 0	71 0	75 0	71 0	75 0	71 0
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120	per 120.
British...	17 11	16 3	—	—	19 7	18 1
Irish	17 6	17 2	17 2	16 1	18 4	17 10
Danish...	—	—	—	—	19 8	17 8
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
British Queen ...	85 0	75 0	73 6	66 6	83 0	75 0
Edward VII.	88 6	81 0	71 6	63 6	81 6	73 0
Up-to-date	81 0	75 0	68 6	61 6	79 0	71 0
HAY:—						
Clover	—	—	168 0	136 0	128 0	117 0
Meadow	—	—	—	—	117 6	108 6

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	WHEAT.						BARLEY.						OATS.					
	1913.		1914.		1915.		1913.		1914.		1915.		1913.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Jan. 2...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
,, 9...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
,, 16...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
,, 23...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
,, 30...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
,, 13...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
,, 20...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
,, 27...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
,, 13...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
,, 20...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
,, 27...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3...	31	4	31	6	54	6	27	0	25	6	31	9	19	2	18	5	30	6
,, 10...	31	3	31	5	54	9	27	8	26	8	31	3	19	2	18	4	30	4
,, 17...	31	6	31	7	55	4	26	11	25	4	30	10	18	10	18	4	30	5
,, 24...	31	8	31	9	56	5	26	7	26	6	31	5	19	3	18	5	30	11
May 1...	32	2	31	9	58	3	25	11	26	0	32	7	19	6	18	5	31	5
,, 8...	32	6	32	2	60	5	25	9	25	6	33	3	19	6	18	9	32	4
,, 15...	32	10	32	7	61	7	25	4	26	3	34	0	19	9	18	11	32	5
,, 22...	32	10	33	0	62	0	25	3	25	10	34	1	19	11	19	0	32	8
,, 29...	32	7	33	9	61	11	26	1	26	1	34	8	20	1	19	4	32	7
June 5...	32	10	34	0	61	9	26	2	25	11	35	4	19	8	19	4	32	5
,, 12...	32	8	34	1	60	1	24	7	24	11	34	5	20	2	19	8	32	4
,, 19...	32	8	34	1	56	1	23	10	25	10	34	3	19	8	19	9	31	9
,, 26...	32	8	34	3	52	0	24	3	25	4	34	4	19	1	20	0	31	9
July 3...	33	1	34	4	49	5	25	2	24	6	35	3	21	0	19	9	31	1
,, 10...	33	4	34	2	50	1	25	10	24	9	34	7	19	4	20	0	31	6
,, 17...	33	6	34	1	52	7	24	9	24	2	35	8	20	5	19	10	31	6
,, 24...	33	10	34	0	53	10	24	1	24	7	35	10	20	8	19	9	32	1
,, 31...	34	1	34	2	55	3	24	5	25	9	36	1	20	3	19	8	31	1
Aug. 7...	34	1	34	9	55	4	24	9	25	2	35	7	19	0	19	1	31	5
,, 14...	34	3	40	3	55	2	24	7	29	4	37	0	18	7	25	1	31	7
,, 21...	33	7	38	9	54	3	26	5	29	10	39	4	18	8	24	3	31	4
,, 28...	32	7	36	2	51	11	29	0	30	3	38	3	17	10	23	5	30	0
Sept. 4...	31	11	36	5	45	3	30	11	30	6	38	1	17	8	23	9	26	10
,, 11...	31	9	37	10	43	0	31	5	29	11	37	11	18	0	23	11	26	8
,, 18...	31	7	38	3	42	9	30	9	29	5	39	0	17	11	23	8	26	4
,, 25...	31	6	37	6	43	3	30	1	29	3	39	8	17	9	23	3	26	1
Oct. 2...	31	3	37	1	43	5	29	9	29	1	40	4	17	10	22	9	26	5
,, 9...	31	0	36	8			29	1	28	10			17	10	22	5		
,, 16...	30	11	36	7			28	8	28	8			17	9	22	4		
,, 23...	30	7	37	2			28	7	28	7			18	0	22	5		
,, 30...	30	1	37	10			28	2	28	3			17	9	23	7		
Nov. 6...	30	0	38	8			28	1	28	6			17	9	23	7		
,, 13...	30	1	39	8			27	8	29	0			17	11	24	8		
,, 20...	30	4	41	0			27	5	29	8			18	1	25	5		
,, 27...	30	9	41	11			27	0	30	3			18	4	25	8		
Dec. 4...	31	2	42	2			26	8	30	2			18	4	25	9		
,, 11...	31	2	42	1			26	5	29	11			18	6	25	9		
,, 18...	31	2	42	7			25	11	29	8			18	5	25	9		
,, 25...	31	0	43	3			25	10	29	9			18	4	25	11		

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of September, 1914 and 1915.

—	WHEAT.		BARLEY.		OATS.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
London	39 2	44 4	30 0	40 4	25 0	27 9
Norwich	37 3	44 1	29 4	38 4	23 10	25 10
Peterborough	37 0	41 11	28 9	38 6	23 6	26 0
Lincoln	37 5	44 1	29 3	38 8	23 3	26 9
Doncaster	36 6	44 2	27 2	36 10	23 1	27 7
Salisbury	37 6	43 11	29 7	38 8	23 8	27 0

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

Imperial Institute.—The World's Supply of Potash. (47 pp.) London: Imperial Institute, 1915. 1*s.* post free. [63.1673.]

Grove, W. B.—The Families of British Flowering Plants. (49 pp.) London: Longmans, Green & Co., 1915. 1*s.* net. [58.19.]

Reed, H. S.—A Manual of Bacteriology for Agricultural and General Science Students. (179 pp.) Boston, U.S.A.: Ginn & Co., 1914. 4*s.* 6*d.* net. [576.8.]

Bayliss, W. M.—The Nature of Enzyme Action. (180 pp.) London: Longmans, Green & Co., 1914. 54(02).

Georgia, A. E.—A Manual of Weeds. (593 pp.) New York: The MacMillan Co., 1914. 8*s.* 6*d.* net. [63.259(02).]

Kuczynski, R., und *Zuntz, N.*—Unsere bisherige und unsere künftige Ernährung im Kriege. (85 pp.) Braunschweig: F. Vieweg & Sohn, 1915. [63(43).]

U.S. Department of Agriculture, Office of the Secretary.—Report 100:—Potash from Kelp. (122 pp. + XL. plates.) Washington, 1915. [63.1673.]

Missouri Agricultural Experiment Station.—Research Bull. 15:—An Experimental Study of the Rest Period in Plants. The Summer Rest of Bulbs and Herbaceous Perennials. (25 pp.) Research Bull. 16:—An Experimental Study of the Rest Period in Plants. Pot-Grown Woody Plants. (27 pp.) Columbia, Miss., 1915. [58(04).]

Field Crops—

Lamborn, L. L.—Cotton Seed Products. (240 pp.) New York: D. Van Nostrand Company. London: Archibald Constable & Co., 1904. [63.34113; 63.604(*a*).]

U.S. Department of Agriculture.—Bull. 238:—Sugar Beets: Preventable Losses in Culture. (21 pp.) Washington, 1915. [63.3432.]

Horticulture—

Logan, A.—First Book of School Gardening. (151 pp.) London: MacMillan & Co., 1915. 1*s.* 6*d.* [63.5(07).]

Lloyd, J. W.—Productive Vegetable Growing. (339 pp.) Philadelphia and London: J. B. Lippincott Company, 1914. $1.50 net. [63.51(02).]

Sears, F. C.—Productive Orcharding. (315 pp.) Philadelphia and London: J. B. Lippincott Company, 1914. $1.50 net. [63.41(02).]

(4107.) Wt. P. 16—9. 7,250. 10/15. J. T. & S., Ltd.

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 8.

NOVEMBER, 1915.

WIRE FENCING.

WILLIAM SOMERVILLE, M.A., D.Sc., D.Œc.,

Sibthorpian Professor of Rural Economy, Oxford.

It is curious how the custom of enclosing fields varies in different parts of the country. In Scotland, and generally throughout England north of the Thames, each field is separately fenced off in some way (hedge, wall, post and rail, wire), whereas on the Downs of Sussex, Hampshire, and Wiltshire, much of the country is quite open except for paddocks or meadows round the homestead. While it is possible that in the North the work of sub-division and enclosing has been overdone, in the South it is certain that fencing might be introduced or extended with great advantage.

The method of management of sheep flocks on the Downs is a very old one, and, in fact, appears to date from the rise and development of sheep-farming in England. A typical Down farm consists of an area of tillage land, on which crops are grown partly for sale and partly for consumption (folding) on the land by sheep, and an outrun of Down on which the sheep flock is daily pastured during a large part of the year.

A Down flock usually consists of 400 to 500 breeding ewes, attention to which entirely occupies the time of a shepherd and his young assistant. From 8 o'clock in the morning in summer, or 9 o'clock in winter, the flock is turned out to pasture on the open Down, the shepherd and his boy being in constant attendance to prevent the flock straying on to tillage land, or on to adjoining farms. North-country or Welsh sheep would probably thrive badly if constantly moved on, or checked, by dogs and men, but the more placid south-country breeds do not seem to mind the treatment, though the sheep would probably thrive better if free to move where they liked within a large enclosure, and to rest or to graze as they felt disposed.

At about 4 o'clock in the afternoon the flock is moved down to a fold which has been erected on tillage land, and there the sheep pass the night. The fold is constructed of hurdles, sometimes of netting, and encloses about an acre of some crop such as vetches, crimson clover, rape, aftermath, rye, barley, or mustard. Often, however, it is what is called "a bare fold," that is to say, it is erected on a summer fallow, and from 4 p.m. to 8 or 9 a.m. the sheep are penned in there, and get nothing to eat. The purpose of the bare fold is to provide a place where the sheep shall be secure for the night, and, incidentally, the land gets trodden and dunged by the sheep. It is evident that the manuring of the tillage land in this way is effected at the expense of the Down pasture, and as the custom has prevailed for centuries it is not surprising that the fertility of the Down grazings has reached a very low ebb.

Cattle are seldom seen on an open Down, for the sufficient reason that, without fences, they cannot be conveniently controlled. So seldom are cattle to be seen on a typical Down pasture that farmers have come to think that they cannot live there, and yet the opposite is the case, for not only do they thrive well, and give a good return in themselves, but they also greatly improve the sheep-sick land that has produced nothing but wool and mutton continuously for centuries. Of course, in its natural condition, the pasture of the Downs is poor food for cattle or any other stock, but if a dressing of basic slag is applied, it furnishes herbage of high feeding quality for all farm animals. In the writer's experience a "slagged" Down will in a normal year produce tegs and lambs quite fit for the butcher without any artificial feeding, while steers come into the yards in October in very forward condition. It is probable that no class of land, represented in England on a large scale, is more immediately and profitably responsive to improved treatment, and yet it is, on the whole, rare to find anything being done.

While the enclosure of Down land by fencing is not an absolutely necessary preliminary to its improvement, it may at least be said that the full benefits will not be secured while the land is unenclosed. Apart altogether from its bearings on manurial treatment, the fencing of a Down at once sets free a man and boy for other useful work during a large part of their time. Moreover, it obviates the necessity for shutting up the sheep nightly in a fold, and allows them to graze late and early, as sheep instinctively do, to their great advantage.

Presumably it is the initial expense that deters farmers from more generally fencing their Downs, and yet this need not be so great as is usually supposed. The cost of fencing depends to a large extent on the shape of the area; for a given area a square requires less fencing than an oblong or triangular area. To take the average case of a Down 1,600 yd. long and 800 yd. wide; this means an area of 264 acres, and necessitates 4,800 yd. of boundary fencing. In normal times an efficient post and wire fence, with a reasonable supply of gates, can be erected for 4½*d.* per yd., or a total of £90; and for another £15 a transverse fence can be put up dividing the area into two fields of 132 acres each. This works out at a capital expenditure of about 8*s.* per acre. The wire, if solid and galvanised, will last for a great many years, but even assuming that the whole fence has a life of only 10 years, it means a sinking fund at 4 per cent. of only 1*s.* per acre per annum (including interest), or £13 4*s.* per annum in all, an expenditure that will never fail to be well repaid.

If, instead of costing 4½*d.* per yd., the fence, with the necessary gates, cost 6*d.* per yd., the total expenditure for the two fields would be £140, or about 10*s.* 6*d.* per acre, necessitating a sinking fund to redeem in 10 years of 1*s.* 3½*d.* per acre per annum (including interest), or a total charge of £17 per annum.

The following is a brief description of some of the tools which will be required: it may be said that no others are likely to produce better work and at the same time be simpler or cheaper:—

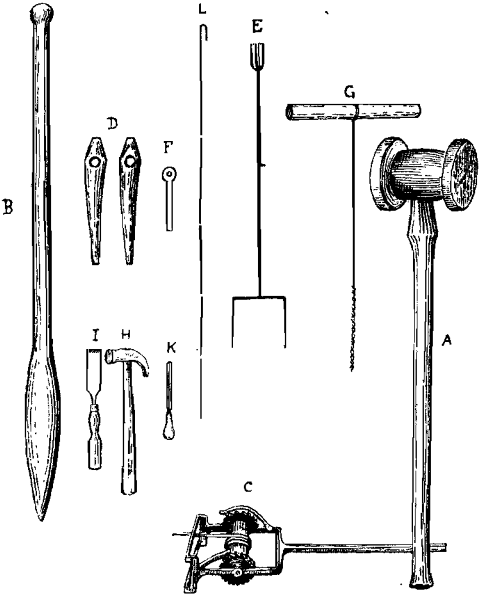
The Mallet or *Mell* (A in Fig.) is of cast iron, weighing 14 lb. It should have a handle or shank 40 in. long of sound hickory or ash. Price with handle 3*s.* 6*d.*

The Soil Borer (B in Fig.) is 4 ft. long, of malleable iron and weighs 14 lb. The so-called "Pitcher" that a south-country shepherd uses for setting his sheep-fold, although sometimes rather too light, will generally answer the purpose. Price 3*s.*

The Ratchet Wire Strainer or "*Monkey*" (C in Fig.) is a simple winch with a barrel about 2 in. in diameter, through which a hole passes to receive the end of the wire. This is the most satisfactory tool for the purpose, and with it one can put on a strain that will break any fencing wire. Price 17*s.* 6*d.*

Two Conical Malleable Iron Pins (D in Fig.) each weighing 1½ lb., and of a total length of 12 in., namely 9 in. from the

point to the hole, and 3 in. from the hole to the thick end. At the thickest part each pin should be 1 in. in diameter, and should taper gradually to the thin end where it should be $\frac{3}{8}$ in. thick. One of these pins is driven into the hole in the straining post when the wire has been sufficiently stretched,



A SET OF FENCING TOOLS.
A—The Mell or Mallet. B—The Soil Borer. C—The Strainer or Monkey. D—Two Conical Holding Pins. E—Holder for Knotting Wire. F—The Wire Knotter. G—The Auger. H—The Claw Hammer. I—The Chisel. K—Triangular File for Cutting Wire. L—The Wire Spacer or Gauge.

and in this way the wire is held tight and prevented from slipping while the monkey is pulled off. The pin must, therefore, be considerably larger at its thickest part than the hole bored in the post. It is well, too, to have it slightly longer, from the thickest part to the small end, than the diameter of the post into which it is driven, so that the thin end may project

slightly beyond the post. When the wire has been stapled round the post it is a simple matter to loosen the pin by striking it with a hammer on the projecting thin end, and, when it has been loosened, its removal is accomplished by putting the thin end of the second pin into the hole in the first pin and rotating it backwards and forwards a few times, when it can easily be withdrawn. It is evident, therefore, that the hole in each pin must be large enough to receive the small end of the other pin. Price per pair 2*s.*

A Holder for Knotting Wire (E in Fig.). This consists of an iron rod $\frac{5}{8}$ in. thick and 2 ft. long. It has at the lower end two prongs, 4 in. long and 6 in. apart, which are pressed by the feet of the worker into the ground, so that it will stand erect. The upper end has a fork or slot $\frac{1}{4}$ in. wide to receive the wire and hold it tight in the process of knotting. Price 2*s.*

The Wire Knotter (F in Fig.) is 6 in. long and $\frac{1}{2}$ in. thick, flattened at one end where it is pierced by a hole large enough to receive up to, say, No. 4 wire, and thus it will also take smaller sizes. When the wire has been placed in the slot of the holder it is a simple matter to wind the end, passed through the hole in the knotter, round the main strand of wire and thus make a loop knot. Price 6*d.*

Scotch Eyed Auger (G in Fig.) making a hole of $\frac{3}{4}$ in. This is used for boring the holes in the straining posts. Price, with handle, 2*s.*

A Claw Hammer (H in Fig.) which should be of steel so that the claws can be sufficiently thin to pass easily behind the wire and the stob or post in drawing a staple already driven home. The hammer should weigh at least 1 lb., because it has to be used not only for driving staples, but also for knocking in the conical iron pins to hold the wire in the straining posts. Price 2*s.* 6*d.*

A Strong Chisel (I in Fig.) 1 in. wide, which is used to make the notch in the straining posts, into which the end of a stay is fitted. Price 1*s.*

A Small Triangular File (K in Fig.), used for making a notch in the spare end of the wire after a knot has been completed, and for cutting wire generally. If the wire is about one-eighth cut through, the end easily breaks off. Price 3*d.*

The Wire Spacer (L in Fig.), made out of fencing wire of average gauge, say, No. 6. A piece of wire is bent $1\frac{1}{2}$ in. at the end in pot-hook fashion, so that it can be conveniently hung on the top wire of the fence. The distances between the lower wires, say, for a six-wire fence, 10 in., 8 in.,

7 in., 6 in. and 6 in., are then marked on the spacer with a file, the spacer being cut off so that when it is hung on the top wire its lowest point will indicate the position of the lowest wire. With the spacing shown above, the distance from the top wire to the bottom one would be 3 ft. 1 in. The spacer is a most useful contrivance, and as one staples any particular wire it is moved along from stob to stob and automatically shows where the wire has to be stapled. It is hung on the top wire, so as to come on the opposite side of the fence from that on which the fencer is working. The marks should, of course, be on the side of the spacer to face the worker. In stapling it is convenient to move along with the fence on one's left side, so that the left hand may move the spacer from post to post, while the right holds the hammer. This saves the trouble of turning round every time a staple is driven in. Sometimes a fencer is seen measuring with a foot rule and marking the position of the wires on each stob. This is a serious waste of time.

A Spade with a 7 in. face is necessary for making the straining-post holes, and for other purposes, while a cold chisel is also convenient for cutting staples already driven home in a straining post, though it is only in exceptional circumstances that it will be required.

The Wire may be solid or strand, but, on the whole, the former is to be preferred. The extra expense involved in having the wire galvanised is fully justified. If one gauge of wire only is used No. 6 is the best, though No. 5, or even No. 4, for the top wire is advisable if heavy stock, and especially horses, are to be restrained. No. 8 is the lightest gauge that is really efficient against stock. Barbed wire may be useful in some districts, but near the coast it is soon attacked by rust. The cost of solid galvanised annealed wire is usually about £12 per ton, though at present it is £20.

The Staples should be of galvanised No. 8 wire and be 1½ in. long. They cost about 5s. per 1,000.

Wooden Straining Posts are usually either of larch or oak, but they may be of Spanish Chestnut, False Acacia, or any other timber that is sufficiently durable. Their length depends on the height of the fence, and whether they are to be used as gate posts. Some people will not use a straining post for hanging a gate, preferring to put in a special post for the purpose. If a straining post when inserted in the ground is not absolutely immovable it certainly will never be satisfactory as a gate post, but there is no reason why it should ever move if properly fixed. The straining of the fence and

the pull of the gate counteract each other, and, in this way, are mutually advantageous. If a gate is not to be hung, the post need not be more than 7 ft. 9 in. in length, that is to say, 4 ft. in the ground and 3 ft. 9 in. out. If the post is to be inserted in a dip of the ground it may have to be 6 in. or even a foot longer. If the wood is good, a minimum thickness of 6 in. at the thin end will suffice. A straining post weighs $\frac{3}{4}$-1 cwt.

The Intermediate Posts (called also Prick Posts, Pointed Posts, Stumps, Stobs, etc.) may be of larch, oak, or Spanish chestnut, or of some inferior wood if creosoted. They may be round, split, or sawn, but in all cases they should have the bark removed. If round they should have a minimum diameter at the small end of $2\frac{1}{2}$ in. for a light fence, or 3 in. to $3\frac{1}{2}$ in. for a heavier one; when sawn or split the cross section at the small end should be at least 6 sq. in. The length will depend chiefly on the height of the fence, but if the ground permits they should be driven in $1\frac{1}{2}$ ft., or even more in very soft soil. With 18 in. in the ground and 42 in. out this means a total length of 5 ft. A stob with a long tapering point is more easily driven into the ground than one with a more abrupt point, but, remembering that the weak part of a stob is just below the surface of the ground, the pointing should be done so as to leave the stob the full thickness there. The weight usually varies between 10 and 15 lb.

The Stays may be of split or sawn oak, or of round larch or Spanish chestnut, and should be cut 8 ft. long, and have a minimum thickness at the small end of 3 in. It is a great mistake to use short, say 5-ft. stays, because if the end is fixed against the post above the top wire, such a stay does not offer sufficient resistance to the strain, and if placed against the post below the top wire the tendency for the post to be lifted out of the ground is greatly increased.

In giving the following description of the method of erecting a wire fence, it is well to point out that a paper description is a poor substitute for a few days as assistant to an experienced workman. On the whole it is best to begin operations by inserting the straining posts in their positions, and if there are any bends or dips in the fence that require dug-in posts, it is well also to have them placed in position before the stobs are inserted. The success of the fence depends to a very large extent on the way in which the straining posts are fixed, because if they "give" to any appreciable extent the fence rapidly becomes slack, and even if the wire is re-strained a few months later it will soon get slack again. Any straining

post can be fixed immovably in a hole 4 ft. deep, and, in fact, if it is difficult to get the post deeper than 3½ ft. this depth will prove sufficient provided a little extra care is given to the details of fixing.

Every straining post should have an "anchor" fixed near its base. This consists of a piece of sound wood about 3 ft. long and 3 in. or so in thickness, which may be round or squared: on the whole it is better squared. With the saw a notch about 2 in. deep is cut within 3 in. of the base of the post, the piece of wood taken out being of such a width that the anchor fits exactly into the slot, so that when it is driven home it is firmly held. To make all secure a 4 in. nail may be driven through the anchor to hold it immovably in position. It does not at all matter whether the anchor or cross piece projects equally on each side of the post or whether the whole of it projects from one side. The hole in the ground to receive the post should be about 3½ ft. long and 12 in. to 15 in. wide, according to the size of the post, but there is no need to throw out more soil than is sufficient to allow the post to be easily inserted. If the end of the fence comes close up against another fence running at right angles, or against a wall or building, the trench for the insertion of the post should lie in the direction of the line of the fence, because only in this way can the terminal post be placed close to the pre-existing fence, building, or wall. If, on the other hand, the end of the fence is a gateway, the trench to receive the post had better be at right angles to the line of the fence; the anchor will then project equally on both sides of the post.

Having dug the hole and ascertained that it is approximately of the right depth, the post with its anchor attached is carefully dropped into the hole, with its centre exactly in the line of the fence. This having been done, a few spadefuls of soil are thrown in and carefully rammed round the foot of the post and along the side of the anchor. In order to get the soil into all the corners and angles of the hole the rammer should not be more than 2½ in. in diameter, and if the post so fills the hole that there is not more than 1 in. or 2 in. of clear space between the sides of the post and the sides of the hole, the rammer for use in packing that part of the hole should not be more than 1 in. in thickness, a piece of wooden rail 3 in. × 1 in. being useful for the purpose.

Having satisfied oneself that the position of the post is right, more soil is filled into the hole, one man shovelling

while another confines himself to packing and ramming, sufficient time being given for the latter to do his work thoroughly. The secure fixing of the post is very largely a matter of thorough packing of the soil, and if a few stones 2 in. to 3 in. in diameter are available they should occasionally be thrown on the soil close to the post and be beaten in. After the filling of the trench has proceeded to the depth of about 1 ft. or so, it is necessary to see once more that the post is perfectly perpendicular, because later it is impossible to rectify a mistake of this kind.

The trench having been filled and thoroughly rammed, the next thing to do is to fix the stay. If the post is a terminal one a single stay is, of course, all that is necessary. Even where the post is an angle one, that is to say, where the line of fence makes a right angle, more or less, at the post, some workmen, by way of economising, put in a single stay, so as to bisect the angle, but such a practice is not to be recommended, because the stay projects into the field and may possibly trip up stock. It is much better to insert two stays at an angle post, each of which will lie along the line of its respective fence. The stays must be sufficiently thick and strong to obviate any chance of bending when the pull of the fence is brought to bear upon them; but a stay 4 in. thick at the butt and 3 in. thick at the other end will suffice if it is of larch, oak, or Spanish chestnut.

A notch 1 to 1½ in. deep is cut with a chisel rather to one side of the median line of the post, and about 2 in. below the point where the top wire will come. This having been done, and the end of the stay having been prepared so as to fit accurately into the notch, the other end is put on the ground at approximately the spot where it will ultimately be fixed. A bevelled hole about 15 in. deep is now made in the ground with a spade, and it is a good plan to make an allowance for a big stone or rough block of wood, say 15 in. long and 6 in. in section, to be placed transversely at the end of the stay, and about 6 in. below the surface of the ground. A little "humouring" will be necessary in order to get the supporting block or stone into its proper position, but the great thing is to see that the position is rather too near than too far from the straining post, because if it is too near it is easy to dig out a little more soil and let the block go back a trifle; and, finally, by using the stay as a battering ram it can be beaten tight against the undisturbed back of soil, and the other end of the stay can be accurately let into the

notch in the straining post. The fixing of the stay in position may be deferred until the stobs are inserted, but this is a detail of little importance.

Having fixed a straining post at each end of the fence, or a post at one end and an intermediate post with a temporary stay in its proper place, the next thing to do is to get the stobs inserted. If the fence is perfectly straight one may stretch a wire from post to post, but if the fence is at all curved the line is better marked off by string or cord. Where a curve occurs in the fence the cord must be laid fairly loosely round this bend, being kept in position at intervals of a few yards by means of pegs. Unless the cord is fairly slack it cannot be made accurately to follow the curve without the use of an excessive number of pegs. As a matter of fact the man who makes the holes for the stobs depends to some extent on his eye to determine their actual position round the bend.

The distance from stob to stob depends upon circumstances; for a very substantial fence the intervals should be 6 ft., whereas for a lighter fence 9-ft. intervals will suffice; while for a light, straight fence to turn sheep and young horned stock, stobs at 36-ft. intervals, with 3 droppers between at 9-ft. intervals, will often prove sufficient (the so-called Corymony fence). Whatever the distance selected it is well to put in the stobs at 6-ft. intervals when negotiating curves, and in this case the stobs must either be propped to resist a thrust, or tied down to stumps with wire to resist a pull. If this is not attended to the fence cannot possibly remain tight for any length of time. If the curve is at all sharp, and especially if it has anything of the nature of an angle, a post must be dug into the ground at that place. Such a post, however, need not be so strong as a straining post, nor need it be put into the ground to a greater distance than 2½ ft. to 3 ft. It must be well propped or tied back, as the case may be. When a fence goes over an abrupt knoll it is a good plan to bore the stobs there and to pass the wire through. Staples are apt to be drawn out of the stobs at such a place by the strong downward pull of the wire. Where a fence crosses a sharp dip in the ground it is essential that a carefully anchored post be dug in and the wires passed through it. If the dip is less abrupt it will suffice to tie down all the stobs at that place. Droppers are unsuitable in crossing dips and knolls.

The cord having been put in position over a length of about 100 yd., the holes for the stobs are then made at the necessary intervals by means of the soil borer, which should be inserted

to a depth of some 15 in., the stobs themselves being driven into the ground to a distance of about 1½ ft., a little more or less depending upon the character of the soil. For turning sheep and light horned stock, a fence 3 ft. 6 in. from the level of the ground to the top wire is sufficient, so that a 5-ft. stob would allow 2 in. above the top wire, 3 ft. 1 in. between the top and bottom wires, 3 in. between the bottom wire and the level of the ground, and 1 ft. 6 in. in the soil.

The holes for the stobs having been made, the process of driving them in may be taken in hand. For this purpose two men are necessary, one to use the mell and the other to keep the stob in a vertical position, or, in the case of a bend, with a slight inclination out or in, as the case may be. The guiding of the stob can be conveniently done by means of a claw hammer, by the aid of which one of the workers either pushes or pulls, as may be necessary. In the first instance the stobs are driven home only approximately to their proper depth. The great thing is not to drive them too far in, but rather to leave them about 2 in. higher out of the ground than will ultimately be necessary.

Having got the stobs roughly inserted in this way, it is next necessary to bore the straining post at the points corresponding with the interspaces between the wires. By applying his eye behind the straining post and looking along the line of the fence, the workman can see exactly where the top hole should come on the straining post, and measuring downwards from there the position of the other holes is determined. For a 6-wire fence a satisfactory spacing would be 10, 8, 7, 6, 6 in., with 3 in. between the lowest wire and the surface of the ground. Should a hole happen to come where a knot occurs on the surface of the post, the auger must be entered with great care, or otherwise the point is apt to be broken off. In the case of a fence of such a length that there is only one intermediate straining post between the terminals it is unnecessary to bore the intermediate post, the wire being attached to it by being wound round. If, however, the fence is so long that there are two or more intermediate posts, then some or all of these must be bored, and must be temporarily stayed until the fence is continued beyond, and thus takes the strain off, the post.

Straining posts are, as a rule, put in too close. A wire fence may be quite well strained over a distance of 250 yd.; in fact, within reasonable limits, the longer the strain the tighter do the wires remain. On the other hand, one often

sees wire fences with straining posts every 50 yd. or less, an arrangement that means considerable increase in cost without any advantage whatever.

Having put in the posts and stobs, the next thing to do—unless wire had already been used instead of cord to get the line of the fence—is to run out the top wire from the coil. This may be done in a variety of ways. Probably the best method is to put the end of the wire through the top hole, where it is held in position by lightly driving in one of the tapering bolts, and then to run the coil along the line of fence, the wire, of course, being paid out as the uncoiling proceeds. Having got to the further post the wire is cut, leaving sufficient to go round the post, to which it is fastened by means of 3 staples, this being quite a sufficient number if the wire makes the full circumference of the post. Some run out the wire in another way, namely, by keeping the coil stationary at one of the terminal posts, a man taking an end of the wire and walking away with it along the line of fence, the man at the coil paying it off in loops. The main objection to this plan is the possibility of the wire slipping out of the hands of the former workman, when it would instantly get ravelled. If there is much fencing to do it is worth while to construct or purchase a turntable mounted on a wheelbarrow. The coil is placed on the turntable and the wire is run out in a simple and most satisfactory manner.

If it is necessary to join two wires, one end is put into the wire holder, and by means of the knotter a neat loop is made; the end of the other length of wire is then passed through and similarly looped, the ends being cut off close, so that possible injury to the clothes of anyone crossing the fence, or to stock, is prevented.

Assuming that the first method of running out the wire, above described, has been adopted, the workman returns to the straining post at which the wire had been temporarily held by means of a tapering bolt and puts the end of the wire through the hole in the barrel of the monkey. When the grip has been well secured the tapering bolt is removed from the post, and care is taken that neither of the cross pieces of the monkey is so near to the hole through the post as to be in the way of the tapering bolt which is ultimately driven into the hole. The monkey is then worked so as to get a severe strain on the wire, and when as much pressure has been put on as is desirable the second worker goes half way along the fence, catches the wire with both hands, and

pulls sidewise, not exactly with all his might but still exercising heavy pressure. When this has been done it will be found that the barrel of the monkey can be wound for two or three more notches ; a further sidewise pull on the wire will induce a little more distention, and so another notch or two is gained. When the first wire has been strained to its utmost capacity, it is very important that about half a dozen heavy blows should be given to the straining post on the side away from the line of fence. This anticipates the post and stay "giving" afterwards, and has much influence in securing a tight fence.

Leaving the monkey on the post with the wire attached the stapling of the wire on the stobs may now be proceeded with. It is a mistake to put the top wire too near the top of the stobs, as this only results in the stobs splitting to a greater or less extent when the staples are driven in ; 2 in. or 2½ in. is near enough to the top of the post for the top wire to come. The staples should be driven in so that they cross the wire exactly at right angles. In this way friction, when further straining is put upon the wire, is reduced to the minimum. If owing to a knot in the wood the staple is slightly skewed, the claw hammer should be used to give it a twist so that it stands precisely at right angles to the wire. The staples should be driven in so as to leave the wire quite free. It is a common and serious mistake to drive the staples home so that they "bite" the wire ; this tends to "nick" the wire and weaken it at that point, and, further, it interferes with the tightening of the wire on any subsequent occasion. Moreover, this method of stapling adds nothing to the tightness of the fence, and nothing so obviously indicates the work of the amateur.

Having got the top wire stapled the next thing to do is for one man to take the mell, and the other to follow him at a distance of 10 or 12 yd. and to indicate which stobs still require driving further into the ground. It can at once be seen which stobs require attention, whether it be merely a light tap or two, or whether more serious driving. If a stob has its point upon a rock or stone so that it cannot be driven in further, or if its head is cracking seriously owing to the use of the mell, it is a mistake to try to force it further into the ground, and such a stob should be cut off with the saw at the proper height.

The stapling of the top wire, and the supplementary driving in of the stobs will still further have slackened the top wire, so that it can now stand a few more notches of the monkey. If, while one man works the monkey the other goes along the fence and with a stob strikes the top wire at intervals

of five or six paces, the wire can be still further tightened up. The great thing, so long as the monkey is attached to the wire, is to see that the wire is strained to its maximum extent, because if this is not attended to now it will mean that in a very short time it will have a tendency to become undesirably slack.

While it is well to have all the wires very tight to begin with, it is not suggested that they should be strained to breaking point, and it is rare that a break occurs in first-quality wire. If, through any cause, a wire breaks in the process of straining, the monkey must be pulled off, the wire pulled out of the post to such an extent as to leave only enough for the monkey to grip, and the broken ends are then joined by knotting.

Having tightened the wire as much as is deemed desirable, it is next necessary to get the monkey off, and the wire stapled round the post. To do this care is taken that the catch of the monkey that pushes against the cogged teeth of the barrel is so far removed from the particular cog in which it is resting that only about one-half or so of the cog grips the catch; or, better still, the catch can be thrown back altogether and the second worker can hold down the end of the handle and thus keep the full strain on the wire. Next, one of the conical bolts is driven into the hole of the post through which the wire passes, the bolt being inserted from the side opposite to that against which the monkey rests. The wire ought to be pressed between the bolt and the *side* of the hole, not the top or bottom, or otherwise it is driven into the fibre of the wood and the grip is not so secure, as it is apt to cause a certain amount of splitting of the post. How far the bolt will have to be driven in is a matter of experience. Old wire, with its rougher surface, is much more easily held than new wire, and the same remark applies to strand as compared with solid wire. After the bolt has been driven in as far as is thought desirable the man who is holding down the handle of the monkey gradually raises the handle to see whether the wire is effectively gripped by the bolt. If this should prove not to be the case, the bolt must be still further driven in. When all is secure the monkey is simply drawn off the wire, and the latter is stapled round the post, three staples being driven full home, to bite the wire. The wire is then cut about an inch from the third staple and slightly bent back in a fish-hook-like fashion, so as effectively to prevent any possibility of its slipping.

The placing of the other wires in position proceeds very much as in the case of the top wire, and when the stapling

stage arrives the gauge or "spacer" is hung on the top wire and the first mark shows the exact position upon the stobs where the second wire is to be stapled, and so on with the other wires.

Cost of Erecting 2,020 *Yards of Fencing in the Spring of* 1914.*

During February, 1914, the writer had occasion to erect 2,020 yds. of fence, and as all the wood and other material had to be purchased, and a careful note was kept of the time of men and horses, the cost can be stated with absolute accuracy.

The surface of the ground was fairly even, though undulating, and, on the whole, the stretches between straining posts were fairly long, in two cases up to nearly 300 yd., the average being about 200 yd. The soil consists of about 9 in. of loam over chalk, and, in places, is rather hard to dig or bore. The ground is about 1 mile from the homestead, and about a similar distance from the railway station. Beyond a day's work in demonstrating operations the writer was unable to do anything himself, and the men who erected the fence had never performed such work before. But they were intelligent and diligent, and rapidly picked up the details of the processes. The fence has now been up for more than a year, and it is proving to be a sound piece of work, which should have a long "life" before it.

The fence consists of 6 wires, the top one being No. 6 gauge, while the others are No. 8.

Where the fence is straight, round, unpeeled Spanish chestnut stobs, 5 ft. 3 in. long, and about 3 in. thick at the small end, were driven in at 36-ft. intervals. These cost 3*d.* each on rail. This spring (1915) 10½-ft. chestnut poles, minimum diameter 3 in. over bark at small end, could be obtained at 25*s.* per 100 f.o.r. When these are divided they make two 5-ft. 3-in. stobs at exactly 1½*d.* each, to which has to be added the cost of cross-cutting and pointing, which would certainly not cost another 1½*d.*, so that 3*d.* seems quite a full price for the stobs actually used in the fence that is being described. The number theoretically required for 2,020 yds. of fence is 168, but as they had to be put in closer round curves, 266 were actually used.

In regard to the cost of preparing round stobs from larch thinnings, the following contract rates prevailed before the war on an estate in Scotland :—

1. Cross-cutting, peeling and pointing stobs 5 ft. 6 in. long, 3½ in. diameter at small end, 1*s.* per dozen.

* It must be emphasised that pre-war prices are quoted.

2. Cross-cutting and pointing (no peeling) stobs 5 ft. long, 2 in. to 2½ in. diameter at small end, 3*d*. per dozen.

3. Cross-cutting and pointing (no peeling) stakes for sheep netting, 5 ft. long, 1¼ in. to 1¾ in. diameter at small end, 2*d*. per dozen.

The writer's original intention was to have three wooden droppers between each pair of stobs (Corymony fence), and a quotation was obtained for these, 39-in. × 1-in. Baltic yellow deal at 1*d*. each. It was found, however, that split ash "spiles," 5 ft. long, dipped in creosote, could be obtained at 1*d*. each f.o.r., and as they would give additional strength to the fence, it was decided to use them. Theoretically, the number required is 505, but actually 423 were used, for the reason explained above, that a large curve in the fence necessitated the use of an extra number of heavy stobs.

The dug-in posts consisted of 15 strainers, 2 holders (for getting round bends), and 4 exclusively for gates. They were obtained by splitting oak logs about 15 in. in diameter into four, and many of them weighed over 1 cwt. each. Although rough, they are very strong, and will probably last for from 30 to 40 years. They would appear to be rather under-priced at 1*s*. each, the price paid for them.

Professional fencers would have erected the fence in less than 15¼ days, but, on the other hand, they would have expected more than 3*s*. per day in wages, so that £7 11*s*. 6*d*. may be regarded as a fair price for the labour.

The following is a detailed statement of the cost of the various items :—

	£	s.	d.	£	s.	d.
19 cwt. No. 8, and 5 cwt. No. 6 solid annealed galvanised wire at £11 10*s*. per ton, carriage paid				13	16	0
5,000 galvanised side-cut staples, 1½ in., No. 8 gauge, at 5*s*. per 1,000				1	5	0
266 Spanish chestnut stobs, 5 ft. 3 in. long, at 3*d*.				3	6	6
423 *split ash " spiles," 5 ft. long, ends dipped in creosote, at* 1*d*.				1	15	3
21 rough split oak straining, holding, and gate posts, 7 ft. 6 in. long, at 1*s*.				1	1	0
16 Spanish chestnut stays, at 4*d*.				0	5	4
111 yards split ash " runners " for special places				1	1	9
Carriage on wood at 7*s*. 10*d*. per ton, for 30 miles				2	10	0
3 gates at 5*s*. 9*d*. and mountings at 6*s*. 6*d*.				1	16	9
2 horses for 2 days, and 1 horse for 1½ days, carting wood and wire at 2*s*. 6*d*. per horse per day				0	13	9
Carters' wages, a man and boy for 2 days, 1 man for 1½ days				0	12	6
Manual labour erecting fence, 2 men 15¼ days at 3*s*.	4	11	6			
Proportion of bailiff's time	3	0	0			
				7	11	6
				£35	15	4

From the detailed statement it will be found that the cost works out at exactly 4¼*d.* per yard, including 3 gates and some paling ("runners.") Excluding these items the cost comes to less than 4*d.* per yard, made up as follows :—

	£	s.	d.	
Wire and staples.. ..	15	1	0	= 1·78 pence per yard.
Wood, including carriage	8	18	1	= 1·06 ,, ,,
Carting materials ..	1	6	3	= 1·06 ,, ,,
Labour erecting fence ..	7	11	6	
Total ..	£32	16	10	= 3·90 ,, ,,

While one can easily imagine circumstances where the cost would be increased, one can as easily picture conditions where the outlay would have been less. In point of fact the fence in question followed an S-shaped bend for some 400 yards, necessitating the tying back and propping of many of the stobs, and the use of more stobs (as contrasted with spiles) than would have been required for a straight run. Moreover, there were three short lengths, which rendered it necessary to use two extra straining posts, but on the whole the fence may be regarded as fairly typical of that required on the Downs of a Southern county.

INFLUENCE OF THE WAR ON SUPPLIES AND USE OF FEEDING STUFFS.

E. T. HALNAN, M.A.

Animal Nutrition Institute, Cambridge University.

THE *problem of the maintenance of an adequate supply* of feeding stuffs during war time is an interesting, though complicated one, and the stock feeder, in view of the instability of the market and uncertainty of delivery, must be prepared to grapple with any new situation that may arise. The present position with regard to live stock is a reassuring one. Although there is an actual slight decrease in cows and breeding sows, the total number of live stock kept, as evidenced by the recent returns, is greater this year than last, and this would indicate that the stock feeder has the utmost confidence in the adequacy of future supplies of feeding stuffs.

There is every reason to believe that factors other than actual shortage are responsible for the present prices. Unfortunately for the farmer, most of the feeding stuffs of agricultural importance, and particularly the oil cakes, are by-products in the manufacture of other materials, and the

manufacturer has to be convinced of the commercial success of the principal product of manufacture before he will risk his money in the laying down of expensive crushing plant. A rise in the price of feeding stuffs is not, therefore, always followed by an increased production, although the raw material may be in abundance, and a temporary serious shortage may occur without any apparent explanation to account for it. The present high prices of the well-known oil cakes are to a large extent due to this factor. Prior to the war our cake consumption was approximately 1,310,000 tons a year, two-thirds of which were crushed at home. Germany's consumption was roughly 1,000,000 tons, all of which was crushed in Germany. England's blockade of Germany has consequently released for consumption elsewhere about 1,600,000 tons of oil seeds, chiefly copra, linseed, cotton seed, and palm kernels. With the increased live stock returns, we should expect our needs to amount to about 1,400,000 tons at a liberal estimate. There is sufficient raw material to produce 2,300,000 tons of cake. As we have seen, however, the crushing plant at our disposal at the outbreak of war was only capable of dealing with approximately one-third of this quantity. Consequently there is bound to be a shortage of cake until new crushing plants are laid down and in working order, in spite of the abundance of raw material. Such arrangements have to some extent already been made, various oil crushers having laid down new plant to deal with oil seeds of Colonial origin, so that considerable quantities of oil cakes, particularly palm kernel, will be available to the farmer for feeding stock this winter. The problem of the supply of concentrated feeding stuffs has, therefore, been partially solved, if the farmer will only show a little adaptability in the matter of feeding what to him are unfamiliar feeding stuffs. Of the cakes in question the supplies of linseed cake and cotton cake are likely to remain inadequate, but there will be a good supply of palm-nut kernel cake, coconut cake and, to a less extent, ground-nut cake available. A considerable amount of work has been done on the two first-named of these unfamiliar feeding stuffs, and enough experience has accumulated to warrant their adoption by the farmer, unaccustomed as he may be to handle them.

Palm-nut Kernel Cake.—Palm-nut kernel cake has been on the market for a considerable number of years, but has received little attention from the English farmer until recently, most of the cake produced in England being exported to

Germany, where it received a ready market at a price of £1 to £2 above the price of £5 5*s.* it commanded in England. Three months after the outbreak of the war, owing to the closure of the principal market, this cake was quoted at Liverpool at £4 17*s.* 6*d.* a ton, and the farmer who bought at this price made a very good bargain. At its present price, £7 10*s.* a ton, it is still an economical feeding stuff to buy. In Germany it has been used with excellent results for feeding dairy cattle, bullocks, sheep and pigs, and all German experiments have shown it to be an economical feeding stuff. At present its use is extending in Scotland and Ireland, and palm-nut kernel meal has given good results when fed to pigs. As far back as 1861, experiments at the Royal Agricultural College, Cirencester, established its value as a feeding stuff.

From bullock-feeding experiments conducted at the Norfolk Agricultural Station, for two months in the winter of 1914, the following conclusion was arrived at. Palm-nut kernel cake and linseed cake have approximately the same feeding value, since the difference observed between the two lots of bullocks fed was considerably smaller than the probable error of the experiment. Bruce, in bullock-feeding experiments undertaken at Spencerfield, for the Edinburgh and East of Scotland Agricultural College, at the same time came to the conclusion that palm-nut kernel cake is a useful feeding stuff, and is about equal in value to the best class of dried distillery grains. Cattle soon take to it, and there appears to be no practical difficulty in feeding it to fattening bullocks when they are accustomed to it from the beginning of the fattening period.

At the Midland Agricultural and Dairy College, this cake was fed to dairy cows, but was not readily eaten by them.

Several large dairy farmers near Glasgow have been using this cake with success. Where butter is made complaints are heard that the cake causes the butter to be of somewhat unpalatable flavour, but there seems to be no need for this to happen if the cake is judiciously used. In cattle-feeding experiments, conducted by the Glasgow and West of Scotland Agricultural College, the cake was found to be slightly superior to bran.

In an experiment carried out at the University College of North Wales, Bangor, in which palm-nut kernel was compared with Egyptian undecorticated cotton cake as a food for milking cows on grass, it was concluded that the results from the consumption of equal quantities of these two cakes were identical. Difficulty was at first experienced with the feeding,

but finally this was overcome. In experiments carried out by the Armstrong College at Offerton Hall, palm-nut kernel cake compared favourably with Bombay cotton cake.

Coconut Cake.—With regard to coconut cake, very little work has been done in this country, but on the Continent it is especially esteemed for feeding to dairy cows. Wakerley has compared it with linseed cake, and reached the conclusion that with linseed cake at over £9 a ton, coconut cake is worth feeding at £6 15s. Bruce, in a feeding experiment conducted in 1911-1912, came to the conclusion that with linseed cake at £10 10s., coconut cake is worth £7 a ton for bullock feeding. The use of coconut cake is extending in the Reading district. A serious charge levelled against both palm-nut kernel cake and coconut cake is their tendency rapidly to go rancid. In reference to this point, it is interesting to note that in an experiment conducted by Mackintosh, of Reading, coconut cake kept in splendid condition from April, 1914, to June, 1915. Provided that these cakes are carefully stored, and are kept in a cool dry place, there is little reason to fear rancidity. There is little doubt, however, that once these cakes get moist, rancidity rapidly sets in.

Ground-nut Cake.—Ground-nut cake is a new feeding stuff, rich in protein, possessing high digestibility coefficients. In the Reading district it is being freely offered, and occasionally purchased, but farmers differ in their opinions of it. The German experimenters have reported favourably of it, and it has proved of particular value for partial replacement of the oat ration of horses. The high protein content renders it especially liable to bacterial attack with the subsequent development of toxic bodies. Occasionally, too, the presence of castor-oil seeds leads to illness in the animals. The cake should, therefore, be fed with great caution, and samples showing the slightest signs of rancidity or bitterness should be instantly rejected.

Dried Yeast.—One other feeding stuff deserves mention. Dried yeast has for some little time been exported to Germany, and 2,000 to 3,000 tons are produced here annually. Dried yeast is very rich in albuminoids, and has been used successfully for all classes of stock. Formerly its use was attended with unfavourable results owing to technical difficulties in drying giving rise to a poor product; but these difficulties seem now to have been overcome. With a view to establishing its qualities as a feeding stuff, Professor Crowther has conducted

of feeding arose owing to the bitter principle contained in the yeast, and its use seems to be unsuitable for this class of animal. The experiments with pigs, however, confirmed its suitability as a feeding stuff for this animal, and its safety was established. Owing to its high protein content, it forms a favourite constituent of patent foods, mixed with such unsuitable materials as peat moss, wood charcoal and hops. One such patent has recently been taken out for a mixture composed of peat moss, yeast, hops, and molasses. It is unnecessary to emphasise here the doubtful value of such proprietary feeding materials.

It is apparent from the above results of English feeding trials that the new feeding stuffs available for stock are capable of replacing the better known oil cakes, and the economical feeding of live stock is possible even should linseed cake and decorticated cotton cake reach prohibitive prices. There is, therefore, little danger in the immediate future of a shortage of concentrated feeding stuffs of a suitable nature for live stock of all descriptions.

GERMAN AGRICULTURE AND THE WAR.*

THE food supply of Germany has very naturally attracted much attention during the past 15 months. The translation of a popular German book explaining the facts as seen from the German point of view appeared on the bookstalls a few months ago;† the current number of the *Quarterly Review* contains a critical study of the question by an English economist,‡ and it is difficult to pick up a daily newspaper without finding some mention of the shortage in the German Empire of this or that article of food. The fact that—thanks to the efficiency of the British Navy—there is not a superabundance of food in Germany is known to everybody in this country who takes any interest in the progress of the war, but the steps which the German Government has taken to husband and increase its resources are not so generally understood.

The following account of the measures adopted in this matter by the German Government is based for the most

---

* It should be noted that the information contained in this article is from German sources.

† *Germany's Food; Can it Last?* English version, edited by S. Russell Wells, M.D., B.Sc. (University of London Press.)

‡ *Germany's Food Supply*, by Prof. W. S. Ashley. (*The Quarterly Review*, No. 445, October, 1915.)

part on a book,* which has been written by two of the collaborators in the work mentioned above, and it deals with action taken in regard to agriculture by the German Government during the first 10 months of the war, and also with the steps which it is considered should be taken during the continuance of the war. Where necessary, however, reference has been made to some of the numerous articles, which have appeared in the German agricultural papers, which have followed this all-important matter with the closest attention.

Before going further, however, it may be desirable to explain that in peace time the Imperial Government centred in Berlin had little or no executive power in matters appertaining to agriculture. The Prussian Government administered in Prussia its own laws relating to agriculture, the Bavarian Government did the same for Bavaria, and in a similar way each of the States, which make up the German Empire, had control in its own territory. With the outbreak of war, however, the Federal Council (Bundesrath) consisting of representatives from each State, was given full power to deal with all economic problems that arose out of the conduct of the war, and it is the Federal Council which is responsible for the food supply of the whole empire. The difficulties which would have arisen if contiguous States took different action in dealing with the same particular question of the food supply were in this way eliminated.

Up to about the year 1870 Germany grew more foodstuffs than were required for home consumption, but the development of her industrial resources resulted in an ever-growing competition between the factories and the farmers for supremacy. By the imposition of heavy import duties on foodstuffs, and in various other ways, the Government endeavoured to maintain a balance between the activities of the manufacturer and the work of the farmer. It was so far successful that at the outbreak of the war Germany was producing about nine-tenths of the food and fodder usually required. In other words, she imported, after allowing for exports, one-tenth of the food she required to feed her people and her livestock. When the war broke out, however, the harvest had not all been gathered in, and the military operations, especially those in East Prussia, caused considerable losses to standing crops, which, together with the resulting disorganisation of the railways and of labour, much enlarged the deficiency of one-tenth.

* *Unsere bisherige und unsere künftige Ernährung im Kriege.* By R. Kuczynski and N. Zuntz. (F. Vieweg und Sohn, Braunschweig, 1915.)

The position, however, was not so serious to Germany as would at first appear, since a large part of the food, such as barley, oats, potatoes, etc., consumed by live stock, would serve equally well for man. If, therefore, a sufficient number of animals were slaughtered, the foodstuffs which they would have consumed could be used in a large measure to cover the deficiency in human food. The obvious plan, therefore, was to reduce the number of animals in the country in just sufficient measure to make the required amount of human food available. The necessary steps to this end were not, however, taken early enough, and it is abundantly plain that the Government did not fully realise the position that had arisen. In passing, it may be observed that much has been written about the elaborate plans which the German Government had prepared in readiness for war, but, however effective may have been the administrative excellence of these plans as regards the army and the railways, it is clear that, as far as the organisation of the food supply of the country was concerned, little or nothing had been done. An interesting article on this subject, written before the war, was published as late as October, 1914.*

Returning to the action taken by the Government, with reference to the slaughter of animals. The year 1913 had brought an exceptionally good harvest, and, as a result of the ample supply of fodder available, the beginning of the war found the number of cattle in the country unusually high. The harvest of 1914 was not so good, and consequently, in normal peace times, lack of fodder would have caused a natural decrease in the number of animals.

The first result of the outbreak of war was to cause farmers in many parts of the country to offer their cattle for sale. This was a movement in the right direction, and would at once have eased the situation as regards food supplies. The Government, however, failed to recognise this, and the Federal Council issued an Order on the 11th September, 1914, forbidding the slaughter of calves under 165 lb. in weight, and of cows under 7 years old; the local governments were also empowered at their discretion to forbid the slaughter of swine. The result of this policy at the beginning of December, 1914, was an actual increase in the number of cattle and swine as compared with the period before the outbreak of war. In December and January, however, the number of swine diminished, and in the meantime also the Government had realised the growing seriousness of the position, and took

* *Die Lebensmittelversorgung unsere Städte für den Kriegsfall.* Zeitschrift für Agrarpolitik, October, 1914.

steps to encourage the slaughter of swine, so that by the middle of March the number had diminished by 29 per cent. There can be no doubt that the whole question was very badly mismanaged, and that if the decrease had been brought about at the very beginning of the war, much anxiety with regard not only to the food supply of the people, but also to that of valuable animals, would have been avoided.

The excessive number of pigs consuming immense quantities of corn, barley, oats, and potatoes undoubtedly led to the shortage of corn for bread which followed, and to the necessity of reducing the oats ration of even the army horses, to say nothing of farm and other horses which suffered severely by the shortage of oats. A large number of the pigs, which were fed at the cost of other more useful animals, and to the detriment of the ultimate well-being of the people, were only barely kept up to weight, and did not increase the supply of meat or lard, so that the foodstuffs they received were in fact a dead loss to the community.

Professor Ashley says: "It was reckoned by a competent authority before the war that the cessation of fodder imports would involve a decrease in the supply of meat to one-half."* That the decrease should be as much as one-half hardly follows from the information available,† but it is important to note that the ultimate effect of the necessary balancing between man and beast of the available food supplies is much more than the one-tenth loss, which the deficiency in fodder of that amount would at the first glance seem to indicate, and it is all the more surprising that the only solution of the question of how to make up the shortage in human food did not form part of the Government's policy from the very beginning of the war. If it had been decided in August, 1914, that the number of cattle and swine should be decreased by 30 per cent. within a certain limited time, most, if not all, of the difficulties with bread and potatoes, which are now to be discussed, would have been avoided.

The 1914 corn harvest was very satisfactory both as regards wheat and rye, the latter forming the staple bread of the German Empire.‡ About one-sixteenth only of the total normal consumption was not produced in the Empire, and since in ordinary times one-ninth of this total was used as fodder, there was ample corn available to allow of the same amount of bread being baked as in peace time. It was only

* *The Quarterly Review*, October, 1915, p. 446.

† But see also the same article, p. 460.

‡ About $\frac{8}{11}$ths of the bread normally consumed is rye bread and $\frac{3}{11}$ths

necessary to take stock of the position, and prevent the increased use of rye and wheat as fodder, in face of the temptation to do so, caused by the lack of imported barley, maize, oil cake, and other feeding stuffs. For three months, however, nothing was done, and it was only on the 4th November, 1914, that an Order was issued prohibiting the use of rye and wheat as fodder. By this time enormous quantities of corn had already been fed to stock, and on the 1st December only one-half of the product of the 1914 harvest was left; the other half and the stocks remaining from the previous year had already been consumed.

During December and January nothing further was done. The prohibition was certainly in force, but the temptation to avoid it was too strong, and during these three months more corn was fed to stock than in ordinary times without prohibition. The seriousness of the position was not realised in time by the Government, and when on the 25th January the Federal Council made it known that on the 1st February the whole stock would be requisitioned by the State it was too late to save the situation in any adequate measure, for on the 1st February only one-third of the 1914 harvest was left.* It cannot be denied that, after having perceived the danger at this late stage, the Government dealt with the question in a courageous manner. A ration per head was prescribed which amounted to only three-fifths of the normal consumption. In spite of the fact that the trade was now controlled by the Government, the price of flour was high, and there was much sharp criticism of the policy of the Government on this account.

The shortage of corn and the increasing cost of meat led to the increased consumption of other foods; the chief of these was the potato.

Germany produces more potatoes than any other country in the world, and the visible supply at the beginning of the war was sufficient to meet the ordinary needs of the people as regards food three times over. The greater part of the potatoes had been used in previous years for fodder and the manufacture of starch and alcohol, and it was only necessary to decrease to some extent the amount used for these purposes in order to provide the additional amount required for human food. During the first months of the war, however, the Government adopted a policy which led to the opposite result. Farmers were exhorted to feed

* For an account of the fixing of prices of corn previous to the requisitioning by the State, see *The Economic Journal*, June, 1915: *Maximum Corn Prices in Germany*, by Mrs. Stocks.

potatoes as much as possible to their stock, and, in addition, a maximum selling price was fixed as from the 28th November, 1914, this also having the effect of encouraging the feeding of stock with potatoes. When, however, the position as regards the low stocks of corn was realised, as described above, the policy hitherto adopted was altered. Warnings were issued calling attention to the necessity of eking out the supply of bread with potatoes, and on the 15th February the maximum selling price was increased considerably.

In the meantime an unusually large quantity of potatoes was being consumed, both as a substitute for bread and as fodder. The Government was called upon to take action, and, in consequence, caused a stock-taking to be made, which later on was found to be very inaccurate, and which showed that the supplies apparently available were unexpectedly small. They came to the decision not to requisition the stocks of potatoes, but to purchase a large quantity with the assistance of the local authorities, who had to buy from the farmers at the maximum price already fixed. Only a small proportion of the amount required, however, was forthcoming; farmers preferred to hold back their stocks in the hope of a higher maximum selling price, or they had already entered into contracts with dealers.

A special Government Department, with considerable powers, and acting in conjunction with the local authorities, was then formed for dealing with the potato question. It was not possible even then to obtain the quantity of potatoes required. Subsequently, however, it appeared that considerable speculation in potatoes had been taking place, and, as a result of what was almost a panic, large stocks which had been held by dealers appeared on the market, with the result that prices fell rapidly. The Government Potato Department was also left with large stocks in hand, and lost a considerable sum of money as a consequence. Had the Government requisitioned the stocks early in the year much speculation would have been avoided, and a period of exceptionally high prices followed by a slump would not have occurred. Steps were taken to make the surplus potatoes available as far as possible for the potato-drying factories, which are now numerous in the German Empire. They produce in large quantities a dried potato flake which has good keeping qualities, and which consequently affords an excellent method for preventing any possible waste in this foodstuff.

From what has been said it will be perceived that the action taken during the first months of the war was not satisfactory. This is to be explained partly by the lack of any definite plan of action, and partly by the disorganisation in the administrative departments following mobilisation, which would lead to irregularity in the receipt of reports from agricultural districts. It must not, however, be supposed that the history of the first year of the war reveals nothing but incompetence on the part of those responsible for the administration of the agricultural resources of the German Empire. On the contrary, there are evident signs that once the seriousness of the position had been realised the various problems arising were adequately considered, and if the solution demanded bold action or the revision of some existing policy there was no holding back by reason of timidity or on account of consideration of political scruples.* It is true that the method adopted of dealing with the potato problem resulted in a fiasco, but it was due rather to the non-patriotic action of gamblers who had much concern for their own pockets and little for the common welfare, than to the inefficiency of the administration. In the present conflict with Germany Great Britain can expect little help from blunders which may be made by that country's agricultural experts. It is evident that every effort is being made to learn from the mistakes which have been made, and, during the next year of war, to make the agricultural resources of the country yield the greatest possible food value.

In the first place, the lesson of the balance between man and animal in the consumption of foodstuffs has been well learnt, and if a German family is to be limited to a maximum of three or four meat dinners a week, it will not be short of bread and potatoes. Meat supplies will be kept up as far as possible by feeding pigs on anything that a pig will eat, but which will not nourish a man. The woods will be used to the full in feeding swine, and cattle will have to eke out their fodder with acacia, horse chestnut, and other leaves.

The harvest now gathered† was not expected to equal that of the immediately preceding years. This was partly due to the expected shortage of labour, and the lack of draught animals, but chiefly to the scarcity of nitrogenous and phosphatic artificial manures. The former class of manures

* See *Zeitschrift für Agrarpolitik*, July, 1915. Bericht der Reichstags-Kommission über die Ernährungsfrage im Kriege.

† The information available points to a considerable decrease in the production as compared with 1914.

is represented by nitrate of soda, of which half a million tons are used annually by Germany for this purpose, and which is now naturally not available; and the latter, by imported phosphates and home-produced basic slag, which, in consequence of decreased iron manufacture, will be scarce.* In particular the sugar-beet crop will be considerably less than in the previous year, and it appears to be unlikely that there will be a surplus that can be fed to animals. The area planted was 30 per cent. less than in the previous year, and if the crop is a poor one, as appears probable, there will be danger of a shortage. It is clear that some time must elapse before Germany will be in a position to resume her export of sugar.

It was stated above that, although the feeding of corn to pigs was prohibited, many farmers fed it in spite of the prohibition. To prevent this occurring again, it is suggested that a maximum selling price for animals should be introduced, so arranged in accordance with the maximum price of corn, meal, and potatoes, that it will be no less profitable to sell these commodities than to feed the animals with them.

The following is a summary of the measures which are recommended by Messrs. Kuczynski and Zuntz in respect of the year following the 1915 harvest† :—

(1) The export of all foods to be stopped, and the import of foods to be encouraged.

(2) The new harvest of rye, wheat, and oats to be requisitioned. Belated action in the first half-year of war led to scarcity in the second half-year, and in the new harvest year there will be smaller stocks, and a smaller harvest. The requisition, therefore, must be more stringent so as to allow the population of the towns more bread, and horse keepers more oats.

(3) The prohibition of the feeding of rye and wheat to animals to be maintained.

(4) Some oats to be allowed to calves and lambs after the requisition has taken place, and horse rations have been fixed.

(5) The maximum prices for rye and wheat to be retained, and only to be raised if the yield is below the ten-year average.

(6) The maximum prices for barley and oats to be raised at least to the level of those for rye.

* *Germany's Food; Can it Last?* p. 17 *et seq.*
† Loc. cit. p. [illegible] *et seq.*

(7) The regulations as to milling rye and wheat to be maintained at least during the first half of the new harvest year.

(8) The measures relating to meal mixtures and bread-making to be simplified. The preparation of wheat bread from pure wheat might be permitted, but the addition of potatoes to rye should be maintained, though the use of potato flakes and meals should be forbidden until the spring.

(9) The meal ration for the population of towns to be raised from 250 grammes to 300 grammes per head per day, according to the results of the harvest.

(10) Greater quantities of potatoes should be dried, and the dried potatoes should not enter into consumption until the spring. Large quantities of fresh potatoes should be used just after harvest for pig feeding. The Government Potato Department should arrange for the supply of the needs of the population of the towns, which should be at least 1 lb. per head per day. It should also arrange for the supply of the necessary amounts to the drying factories, which should not release their stocks until the 1st March; and it should arrange how much can be fed to animals.

(11) Maximum prices for potatoes should be fixed according to harvest results, allowing moderately increasing extra payments for storage if the potatoes are taken from farmers after the 15th April.

(12) Maximum prices for pigs should be fixed so as to harmonise with the maximum prices for feeding stuffs. If, then, it proves impossible to get a sufficient supply of pork, a real expropriation should be carried out.

(13) Trade prices as well as producers' prices should be fixed so as to give consumers the benefit.

(14) Stronger measures to prevent damage to the harvest by game, etc., should be taken. Money compensation has the disadvantage that the whole community suffers from the smaller harvest.

(15) Feeding stuffs available in trees and in woods should be used.

(16) More efficient statistics of yields and of stocks should be taken.

(17) Censuses of animals should be taken on the 1st August, 1st December, and 1st April, and pigs in addition on 1st

October, 1st February, and 1st June, distinguishing the different classes.

The reasons for the growing scarcity of wool do not come within the scope of this article, but the question of fat is one that may be touched upon. Before the war large quantities of fat for margarine making and other purposes were imported, and the lack of this import, together with the lessened supply of fats produced in the Empire is undoubtedly causing considerable inconvenience. In this connection it is interesting to note that, as late as the 9th October last, the Federal Council issued an Order prohibiting the use of pure animal and vegetable oils and fats for industrial purposes, such as the oiling of machinery.* The oils used for such purposes must not contain more than 25 per cent. of animal or vegetable oils and fats.

THE FEEDING AND MANURIAL VALUES OF SUGAR BEET CROWNS AND LEAVES.

A COMMISSION of Dutch experts has recently concluded an enquiry into the feeding and manurial values of sugar beet crowns and leaves, and the results of their labours have been published by the Dutch Ministry of Agriculture, etc. (*Verslagen en Mededeelingen*, 1915, No. 4.) The enquiry related principally to conditions in the Dutch province of Zeeland, but in view of the interest of the subject to English sugar beet growers an account of the committee's findings may be given ; it must be understood throughout that the recommendations are those of the Dutch Commission and not of the Board.

Yield.—In some trials in Groningen, in 1906-7, an average yield of 25,000 lb. of sugar beet crowns and leaves per acre was obtained ; in the province of Zeeland the yield of crowns and leaves has varied between 18,000 lb. and 36,000 lb., with an average of 24,000 lb., containing 80·9 per cent. of water and 4·5 per cent. of dirt.†

* *Zeitschrift der Spiritusindustrie*, 14th October, 1915.

† It must be noted that these yields, quoted by the Dutch Commission are far in excess of those usually stated. Actual weighings and estimates in England give about 3 tons per acre as the figure.

Ten analyses were carried out in Zeeland in 1911 and 1912 of crowns and leaves that had lain for from 2 to 14 days on the land, and the following figures were obtained :—

	Average.	Minimum.	Maximum.
Crude Protein	2·37	1·5	3·8
Pure Protein	1·83	1·1	3·1
Digestible Protein	0·92	0·7	1·7
Sugar	2·81	0·8	4·9
Carbohydrates	5·43	3·8	8·7
Crude Fat	0·40	0·3	0·7
Crude Fibre	3·05	1·9	5·2
Ash	5·41	1·5	9·5
Dirt	3·57	0·2	6·9
Moisture	80·51	73·0	87·9

On the basis of these Zeeland figures, and taking Weiser and Tangl's digestibility coefficients,* crowns and leaves would average as follows, as fed fresh in practice: 19·5 per cent. dry matter (of which 3·6 per cent. is dirt), 1·1 per cent. digestible protein, 7·3 per cent. digestible carbohydrates, 2·3 per cent. digestible fibre, 0 1 per cent. digestible fat, and starch equivalent 9·1.

With 1·1 per cent. digestible protein and 9·1 starch value, 100 lb. crowns and leaves would be equal in feeding value to 100 lb. roots, 2·1 lb. cotton-seed meal and ½ lb. maize meal (the dry matter in roots is reckoned at 13·5 per cent.) *e.g.* :—

	Dig. Protein.	Starch Value.
	lb.	lb.
100 lb. roots	0·2	7·2
2·1 ,, cotton-seed meal	0·83	1·51
0·5 ,, maize meal	0·04	0·40
	1·07	9·11

Reckoning the prices per 100 lb. of roots at 6*d*., of 100 lb. cotton-seed meal at 8*s*. and of 100 lb. maize meal at 5*s*. 10*d*., the Commission estimate that the crowns and leaves would be worth 8½*d*. per 100 lb. or, say, 16*s*. per ton. The Commission arrive at a somewhat lower value for crowns and leaves by comparing them with pulp and cotton-seed meal; 100 lb. crowns and leaves would have the same feeding value as 120 lb. pulp and 2 lb. cotton-seed meal, thus :—

* Weiser and Tangl carried out digestibility experiments with sheep and obtained the following digestibility coefficients: Crude protein, 73·9; pure protein, 62·5; carbohydrates, 89·0; crude fat, 21·9; crude fibre, 74·8; total dry matter, 75·0 per cent.

	Dig. Protein.	Starch Value.
	lb.	lb.
120 lb. pulp	0·36	7·8
2 „ cotton-seed meal	0·79	1·44
	1·15	9·24

Reckoning in all losses that occur until the pulp is fed, 100 lb. are priced at 4½*d.* so that the value of crowns and leaves would be 7*d.* per 100 lb. or, say, 13*s.* per ton. Taking the average of these two price estimates the value of crowns and leaves would be 14*s.* 6*d.* per ton. On the basis of the Zeeland yield of 24,000 lb. per acre, the value of the crowns and leaves per acre would be £6 15*s.* (reckoning a loss of 15 per cent. before feeding).*

It is acknowledged by continental farmers that the crowns and leaves have a higher feeding value than roots, both milch and fattening animals being known to go back in condition when crowns and leaves are replaced by an even greater quantity of roots. Further testimony to the excellent feeding value of crowns and leaves is seen in the fact that at the time of the sugar beet harvest in Holland milch cows give a great deal of milk with a high fat content and at the same time maintain very good condition; and a very favourable effect is also noticeable in the case of fattening cattle.

The Feeding of Fresh Crowns and Leaves.—There is no doubt that the feeding of this by-product as green fodder is the most profitable method of use. It is the least costly method, the digestibility is the greatest, the loss by fermentation and rotting is unimportant, and at the time of the sugar beet harvest green fodder is getting scarce. Cattle can be (1) driven on the arable land after beet harvest, or (2) the crowns and leaves can be collected and placed on the grass land either in heaps or spread out over the land, or, lastly (3) the cattle can be stall fed with the crowns and leaves with the addition of concentrated foods and straw.

The first is the most usual method in Zeeland, dairy cattle, fattening cattle and young cattle above one year, and to a less extent horses, sheep and even calves, being driven on the beet fields immediately after harvest and kept there until the middle of November as a rule, but in some cases till the middle of December or even later, much, of course, depending on the weather. The great advantage of this method is that very

* The value of crowns and leaves per acre in England, on the basis of a yield of 3 tons, is usually placed at about 20*s.* per acre.

ittle labour is necessary for the care of the animals. On the other hand, the arable land may suffer from the trampling of animals, especially in wet weather ; on light, porous lands the damage caused is not so great. The trampling of the animals on the crowns and leaves may also lead to much loss of the latter (from 30 to 50 per cent.), but, with dry weather and the employment of animal attendants to ensure that the animals eat off one part of the field at a time, this loss, it seems, may be much reduced (viz., to from 10 to 15 per cent.). Finally, the health of animals may suffer in bad weather, and if the animals are not housed during the night, owing, it is believed, to the dirty condition of the animals, the wet situation, the consumption of large quantities of dirt and the occurrence of diarrhœa. Housing the animals during the night, feeding the crowns and leaves in clean condition, and supplementing with hay, straw and concentrated foods, seem very effective preventive measures.

Some Zeeland farmers always feed the crowns and leaves to animals on grass, while others only do this in wet weather ; by this method less fodder is lost and arable land does not suffer so much by trampling in wet weather. To prevent loss, not too much must be allowed the animals at one time, and the crowns and leaves should be spread out over the land as much as possible ; there will thus be less trampling of fodder, and the cows will be quieter as they will not herd together. Distribution of the fodder all over the field will ensure, in addition, even manuring. The chief disadvantage of this method of use is that it is costly in labour, both of men and horses. It may also impair, unduly, the fertility of the arable land. Housing at night and supplementary feeding with dry food are desirable at the end of autumn and in bad weather.

Stall feeding is not common in Zeeland, but excellent results are obtained in the Wilhelmina polder where the supplementary foods are straw and meat meal. One Zeeland farmer has successfully fed cows in this way for several years. The animals are stalled at the beginning of beet harvest, and one man with horse and cart is able to carry out the feeding of 20 animals.

On the basis of the requisite amounts of dry matter, digestible protein and starch equivalent laid down by Kellner, the Commission recommend the following rations*: For *fattening*

* These quantities of crowns and leaves recommended by the Dutch Commission are very large compared with those recommended by German authorities

cattle of 1,000 lb. live weight—120 lb. crowns and leaves, 4 lb. meadow hay, 6 lb. oat straw and 2 lb. cotton-seed meal; *for young growing cattle* of 800 lb.—80 lb. crowns and leaves, 2 lb. meadow hay, 6 lb. oat straw and 1 lb. cotton-seed meal; *for milch cows* with a live weight of 1,200 lb. and a milk yield of 24 lb.—80 lb. crowns and leaves, 8 lb. meadow hay, 1 lb. wheat chaff, 1 lb. oat chaff and 2 lb. ground-nut cake; *for pigs* at beginning of fattening per 100 lb. live weight—14 lb. crowns and leaves, 0·7 lb. pea meal, 1 lb. maize meal, 1 lb. barley meal.

Results of Feeding of Crowns and Leaves.—Excessive feeding of crowns and leaves has, in some instances, been harmful to the health of animals, diarrhœa, symptoms of poisoning and bone-weakness having been observed.

Diarrhœa is in all probability not to be ascribed to the dirt adhering to the crowns and leaves; and Müller and Wendt, who investigated the question, concluded that it did not result from the oxalic acid present, but from bacterial infection of dirty leaves, the risk of diarrhœa being diminished the drier and the cleaner the leaves.

As regards poisoning following the consumption of large quantities of crowns and leaves, the cause was ascribed, in a case which occurred in the present year, and which was investigated by a Hanover veterinary surgeon, to the oxalic acid; the content of oxalic acid is known to increase in dry weather.

Finally, bone-weakness has been noticed with long continued feeding and especially when the crowns and leaves have turned sour.

The following measures are recommended by the Commission:—

(1) Care should be exercised as to feeding crowns and leaves harvested in the early morning dew, or in wet weather; diarrhœa is much less liable to result with crowns and leaves harvested dry.

(2) Where circumstances permit, the beets should be cleared off in the middle of the day and the leaves not left on the land longer than is absolutely necessary. On smaller farms, where labour is available, crowns and leaves should be spread out in thin layers on grass and clover land.

(3) The crowns and leaves should be fed with care when a very dry summer and autumn have been experienced, on account of the risk of poisoning. If the ration of crowns and

leaves were gradually increased, harmful effects could be observed before they had a fatal outcome.

(4) Supplementary feeding with straw and hay is very desirable.

(5) The addition of chalk to the ration is not desirable ; it increases the diarrhœa, especially when the leaves are dirty.

(6) A small quantity of phosphate of lime should be fed every day ; from $\frac{7}{10}$ oz. to $1\frac{1}{2}$ oz. is sufficient for dairy cows, larger quantities having an unfavourable effect on the milk products.

Practical farmers in Holland are agreed that, when milk cows go from the scanty pasture to feeding with crowns and leaves, both the yield and fat content of the milk increase. The following figures relate to a small dairy, the supplying farmers being all beet growers :—

Period.	Milk delivered per day (kg.).	Fat average percentage.
September 17th to 30th... ...	1,540	3·22
October 1st to 14th	1,580	3·30
,, 15th to 28th	1,880	3·37
,, 29th to November 11th	1,980	3·41
November 12th to ,, 25th	1,980	3·37
,, 26th to December 9th	1,870	3·28

The beet harvest commenced at the beginning of October and from 15th to 28th October all cows received crowns and leaves, this fodder taking a smaller place in the ration from the latter half of November.

In the case of another dairy, particulars were obtained as to 12 farmers who fed crowns and leaves in large quantities. The feeding began in October ; the average fat percentages for the milk of the whole 12 farmers were : In July 3·09 per cent., in August 3·12 per cent., in September 3·19 per cent., in October 3·38 per cent., in November 3·49 per cent., and in December 3·38 per cent. The average fat content of the milk of 88 cows in Zeeland control unions was 3·39 per cent. previous to feeding with beet leaves in 1914, and 3·56 per cent. three weeks later when all cows were on leaves. The same fact was elicited by enquiries addressed to individual farmers, the increase being said to be not so noticeable with pastures in good condition, or with animals longer than six months in milk.

The butter is firm, granular, and churned with difficulty, and the taste is inferior ; these defects could be remedied by

reducing the quantity of this fodder in the rations and using such supplementary foods as give a soft butter fat.

Further, in many cases the milk does not seem to be very well suited to human consumption as it has an unpleasant smell and taste and has been known to cause diarrhœa in children. The cause is bacterial infection of the milk combined with chemical changes in the fat, the bacteria on the leaves reaching the milk either directly through particles of the fodder falling in the milk pail, or, indirectly, *i.e.*, by way of the manure. It is very difficult to obtain clean milk during the feeding, diarrhœa and the dirt in the food leading to a dirty condition of the cows.

Smell, taste, and cleanliness are very favourably influenced by:

(1) Care in feeding undamaged crowns and leaves.

(2) Limiting the amount of crowns and leaves fed and supplementing them with other foods, such as meadow and clover hay, bran, linseed meal, ground-nut cake and rice meal.

(3) Keeping the cows as clean as possible.

(4) Milking in places where the air is not contaminated by rotting leaves, and cleaning the stall and fodder troughs well and often.

The Separate Use of Crowns.—It has been stated above that sugar beet crowns and leaves are best used fresh. Where the head of stock kept is not sufficiently large, and for other reasons, this method may not be possible throughout.

The first method possible in such cases is the removal of the crown with only a small part of the leaf stems adhering. On the average of 8 investigations in Zeeland, yields of 38,933 lb. of beets, 6,036 lb. of crowns, and 18,828 lb. of leaves per acre were obtained; thus crowns formed one quarter of the total weight of crowns and leaves. In harvesting, the leaves are cut off first, then the crowns, the latter being placed in small heaps and subsequently collected in sacks and brought to the farmstead; the disadvantage of this method is that, in working quickly, too large an amount of crown may be cut off, and the alternative is separation of crowns from leaves after removal of the beets. The crowns are stored in heaps about 3 ft. wide and 1½ ft. to 2½ ft. high, the heaps being turned over at least once every month; covering with straw, etc., is necessary as a protection from frost.

The sugar content of the crowns is from 3 to 6 per cent. lower than that of beets, but the content of nitrogenous

substances is about twice as great. There are no analyses in the text books of crowns with part of the leaf stems adhering, such as occurs in practice, so that special analyses were carried out of crowns as harvested in Zeeland. Combined with Tangl and Weiser's digestibility figures, these show the following average results: dry matter, 23·4 per cent. (of which 2·33 per cent. is dirt), digestible protein 1·1 per cent., digestible fat 0·1 per cent., digestible carbohydrates 12·7 per cent., digestible fibre 2 per cent., starch equivalent 12·7.

On the basis of these figures 100 lb. crowns would have the feeding value of 80 lb. roots, and 11 lb. barley meal; or of 100 lb. pulp, and 21 lb. hay. The following rations are recommended by the Dutch Commission: *milk cows* of 1,200 lb. live weight, and 24 lb. milk yield, 46 lb. crowns, 10 lb. meadow hay, 1 lb. wheat chaff, 1 lb. oat chaff, 3 lb. ground-nut cake, 40 lb. roots; *fattening animals* of 1,000 lb. at beginning of fattening period, 64 lb. crowns, 2 lb. meadow hay, 2 lb. cut aftermath, 2 lb. cut pea straw, 1 lb. wheat chaff, 1 lb. oat chaff, 1 lb. meat meal, 1 lb. linseed meal, and 20 lb. roots; *young growing cattle* of 800 lb. live weight, 44 lb. crowns, 2 lb. meadow hay, 2 lb. cut aftermath, 2 lb. cut pea straw, ½ lb. wheat chaff, ½ lb. oat chaff, 1 lb. meat meal, and 20 lb. roots; *pigs* at beginning of fattening, per 100 lb. live weight, 10 lb. crowns, 0·3 lb. linseed meal, 0·4 lb. pea meal, 1 lb. maize meal, and 1 lb. barley meal; *draught horses*, at moderate work per 1,500 lb. live weight, 30 lb. crowns, 12 lb. meadow hay, 8 lb. pea straw, and 10 lb. oats. For cattle and sheep roots may be replaced by pulp, 100 lb. mangolds being equal to 110 lb. fresh pulp. or 14 lb. dry pulp.

Crowns appear to be a good food for sheep, horses, and pigs.

Silage from Crowns and Leaves.—The second method possible where the crowns and leaves cannot all be fed fresh is to convert the fodder into silage. In ensiling loss occurs (*a*) of weight, (*b*) of nutrients, (*c*) of digestibility. (*a*) With careful management, 100 lb. fresh tops and leaves will give 67½ lb. of silage fit for feeding. (*b*) The following are the average increases (+) or decreases (—) found in four tests in Zeeland and by Tangl and Weiser (reckoned as percentages on fresh constituents): *crude protein* — 3·90 per cent., pure protein + 7·90 per cent., digestible protein — 37·40 per cent., sugar — 94·80 per cent., carbohydrates + 43 per cent., crude fat + 11·80 per cent., crude fibre + 3·60 per cent., ash + 64 per cent., dirt + 86 per cent., water [illegible]

cent. (*c*) The results of Tangl and Weiser's investigations are as follows (percentage digestible, fresh given first, silage second): organic substances 82·5, 60·3; crude protein 73·9, 46·0; pure protein 62·5, 34·9; crude fibre 74·8, 52·2; carbohydrates 89·0, 72·8.

Reckoning a loss of 29·5 per cent. in ensiling, and that a further 3 per cent. will not be fit for feeding, the yield of silage will be about 16,262 lb. per acre. From the foregoing data this may be expected to contain 22·2 per cent. dry matter, 6·6 per cent. dirt, 0·7 per cent. digestible protein, 5·8 per cent. digestible carbohydrates, 1·6 per cent. digestible fibre, and a starch equivalent of 7·3 per cent. Thus 100 lb. of silage would be equal in feeding value to 90 lb. roots and 1·3 lb. cotton-seed meal; or to 50 lb. pulp, 10 lb. hay and 1½ lb. barley meal.

The Dutch Commission recommend the following rations: *fattening cattle* of 1,150 lb. live weight, 32 lb. silage, 4 lb. meadow hay, 1 lb. cut aftermath hay, 2 lb. cut pea straw, ½ lb. wheat chaff, ½ lb. oat chaff, 2 lb. ground nut cake, 6 lb. second quality wheat, and 30 lb. roots; *young growing cattle* of 800 lb. live weight, 32 lb. silage, 6 lb. meadow hay, 4 lb. cut oat straw, 3 lb. cut pea straw, 2 lb. cotton-seed meal, 20 lb. pulp, and 30 lb. roots; *dairy cows* of 1,200 lb. live weight, and milk yield of 24 lb., 50 lb. silage, 10 lb. meadow hay, 1 lb. wheat chaff, 1 lb. oat chaff, 2 lb. linseed meal, 3 lb. ground-nut cake, 40 lb. roots; *pigs* at beginning of fattening period, per 100 lb. live weight, 12 lb. silage, 0·3 lb. linseed meal, 0·8 lb. pea meal, 0·8 lb. maize meal, and 1 lb. barley meal.

Drying of Crowns and Leaves.—The third method of using surplus crowns and leaves is by drying. Methods of drying were commenced in Germany on account of the large loss in ensiling. On small farms in favourable weather drying in the open may be resorted to, but most of the drying is done in the special apparatus which has been erected in various parts of Germany, there being four different methods in use. No loss of digestibility, except of protein, seems to occur on drying. Experiments with dried crowns and leaves show that the fodder has a feeding value somewhat less than that of good meadow hay.

The special conditions obtaining in the Netherlands are thought to preclude any great extension of artificial drying in that country. The best method of using the crowns and leaves is, therefore, stated to be as follows:—

At the beginning of the beet harvest some of the cattle are stalled, the rest of the animals being left to depasture the fields; thereafter all cattle are stalled. Leaves and crowns will form the principal food, being supplemented with a little hay or straw or some concentrated food. Feeding with fresh leaves and crowns will be continued until a fortnight or three weeks after the end of beet harvest. If the amount of crowns harvested is so large that they are stored in heaps, a ration consisting principally of beet crowns can be fed till the end of January. Finally, where crowns and leaves have been ensiled or dried, they may form a considerable part of the ration from the end of January onwards.

Manurial Value of Crowns and Leaves.—It is well known to beet growers that the ploughing under of crowns and leaves is attended with good results for the following crop. German estimates of the manurial value vary between 12s. and 20s. per acre. At Lauchstadt the crowns and leaves from 1 acre were found to contain 119 lb. nitrogen, 41 lb. phosphoric acid, and 152 lb. potash. These figures were higher than those obtained in Zeeland on the basis of Zeeland analyses and Zeeland yields, viz., 92 lb. nitrogen, 28 lb. phosphoric acid, and 125 lb. potash per acre. The leaves of the sugar beet contain, per acre, larger quantities of plant nutrients than are found in the leaves of other "roots."

At Lauchstadt oats were grown on plots on which the crowns and leaves had, and had not, been ploughed in; the increase resulting from the crowns and leaves was 856 lb. grain, and 674 lb. straw per acre. Experiments with potatoes were carried out in Holland in 1912 and 1913 to test the point. In the first, the ploughing under of the crowns and leaves produced a total increase of 1,000 lb. where artificials were used, and of 1,017 lb. where no artificials were used, on the two sets of plots; the percentage of larger-sized potatoes was greater on the plots manured with crowns and leaves. In the second experiment the increased yields were 480 lb. (artificials on both sets of plots), and 1,856 lb. (no artificials) respectively, the percentage of large tubers again being greater. In the third experiment leaves and crowns were separately tested, leaves being applied at the rate of 26,200 lb., and crowns at the rate of 22,600 lb. per acre (or, respectively, two and three times the actual yield); the total yields of potatoes per acre were:—Unmanured 22,272 lb.; leaves, 24,014 lb.; crowns, 25,221 lb. The manuring and yields in the fourth experiment were as follows, per acre:

unmanured, 17,236 lb.; leaves and crowns (17,007 lb. per acre), 18,180 lb.; leaves alone (11,368 lb. per acre), 18,308 lb.; leaves and crowns (17,007 lb.) and ammonium phosphate (647 lb.), 23,369 lb.; ammonium phosphate alone (647 lb. per acre), 22,483 lb.

In view of the present difficulty of obtaining artificial potash manures, the desirability of growing potatoes after sugar beet, where practicable, might well be considered.

DEMONSTRATIONS OF MOTOR PLOUGHS AND TRACTORS.

As a result of suggestions made by the Board of Agriculture and Fisheries, demonstrations of labour-saving machinery have recently been carried out by the County Councils of Lincoln (Lindsey), Essex, and Northants, the Suffolk Agricultural Association in conjunction with the East Suffolk County Council, and the University of Cambridge. (Since the date of writing, another demonstration has been held in Yorkshire under the auspices of the Yorkshire Agricultural Society and the Yorkshire Council for Agricultural Education.)

Although such labour-saving devices as potato diggers, dung spreaders, a turnip-topping and tailing machine, a turnip thinner and horse hoe, a root cleaner and cutter, a hedge cutter for horse power, a pig-feeding machine, milking machines, and model silos were exhibited, the demonstrations had regard chiefly to motor ploughs and tractors.

From the point of view of the attendance and interest aroused on the part of farmers, the demonstrations were all extremely successful; thus, it is estimated that over 1,000 people were present at each of the two demonstrations in Lincolnshire, and at Chelmsford the attendance numbered some 400 to 500, including members of the Departmental Committee on the Home Production of Food. Several hundreds were also present at the other demonstrations.

The conditions under which the trials of motor ploughs and tractors took place were, perhaps, too favourable for definite conclusions to be formed as to the general usefulness of the various machines. The weather was fine in all cases, and the land generally dry; the soils were, as a rule, light, but in the Cambridge demonstration the soil was a heavy loam, in places changing to a heavy clay, and in others to a lighter loam. It must, of course, be remembered, on the other hand, that wet weather need not seriously interfere with the employment

of motor ploughs and tractors, since the work may be done sufficiently quickly to be accomplished in spells of fine weather. It is probable that the motor ploughs and the lighter tractors will usually be workable under the same weather conditions as horse-drawn ploughs. The soil in the Cambridge demonstration was so hard that it was doubtful whether horse ploughs would have worked successfully. Cross ploughing, and the ploughing in of dung, were not tested in these demonstrations.

The number of machines tested was affected by the difficulty experienced by manufacturers in supplying machines and men, and by difficulties of transit. In some cases the railway companies were able to afford special facilities for delivery.

The prices of the motor ploughs (combining plough and motor in one) tested are lower than those of the tractors (*i.e.*, without ploughs); the motor plough would probably be most suitable where the ploughing can be spread over several months. On the other hand, the tractor is favoured where large areas have to be ploughed quickly, and where there is much haulage and threshing to be done.

Various particulars as to the motor ploughs and tractors tested are given in the table on p. 762.

Demonstrations of the *Fowler-Wyles Motor Plough* were given at Frithville (Lincolnshire), and Bramford (East Suffolk), at both of which places it did good work. The motor drives two spiked wheels, and is very simply controlled with one lever by a man sitting at the rear; the plough may be used for either single or double-furrow work. Its small size (3 ft. high by 2 ft. 4 in. wide) allows of its employment in hop gardens and orchards where horses are less suitable. It seems to be capable of ploughing about 3 acres per day. Various kinds of farm work other than ploughing, *e.g.*, cultivating, are possible. When not in use in the fields the engine may be used for grinding, chaff cutting, etc.

The *Wyles Motor Plough* is similar in type to the foregoing, and is adapted for the same kinds of field work. It is, however, fitted with a more powerful engine. It did very good work at Chelmsford. A suitable pulley is attached for belt driving.

Martin's Motor Plough was exhibited at Frithville, Appleby (Lincolnshire), Cambridge, and Bramford, and did good work. The feature of this machine is that it obtains its motion from an endless chain or "creeper" 6 in. wide, giving a 3-ft. continuous tread. There is a creeper on each side, and the one

Name.	Manufacturers.	H.P. (h.p. at drawbar in brackets).	Weight.	Fuel.	Plough.	Price.
			T. c.			£
Motor Ploughs.						
"Fowler-Wyles" Plough ...	John Fowler & Co. (Leeds), Ltd. ...	8—9	16	Petrol or benzol	2 furrow ...	158
Wyles Motor Plough	Wyles Motor Ploughs, Ltd., Manchester.	11—12	1 2	" "	2 " ...	172
Martin's Motor Plough ...	Martin's Cultivator Co., Stamford ...	15—16	—	Petrol	2 " ...	200
Crawley's Motor Plough ...	Crawley Bros., Hadstock	30	1 10	"	3 " ...	—
Tractors.						
Weeks-Dungey "Simplex"...	Weeks & Son, Ltd., Maidstone ...	22½	1 5	"	2–3 " ...	210
"Big Bull." or "John Bull"	(Agents) Cyrus Robinson & Co, 61, Holland Road, London, W.	20 [7]	2 0	"	3 " ...	230
"Mogul"	International Harvester Co., London	25	4 5	Paraffin or petrol	3–5 " ...	400
"Daimler"	Daimler Co., Ltd., Coventry ...	40	4 10	Petrol	4 " ...	600
Saunderson's "Universal" Model "G."	Saunderson & Mills, Ltd., Bedford...	20	2 15	Mineral spirit or paraffin.	3-4 " ...	325
"Sandusky"	(Agents) Mills & Son, Ltd., Paddington.	brake 40—45 [15]	3 10	Petrol	4 " ...	578
"Overtime"	Overtime Farm Traction Co., London	24 [12]	2 3	Paraffin ...	3 " ...	231
"Ivel"	The Ivel Agricultural Motors, Ltd., Biggleswade.	24	1 17	" ...	3 " ...	265
Mann's Steam Tractor ...	Mann's Patent Steam Cart and Wagon Co., Ltd., Leeds.	—	4 10	Coal or coke ...	4 " ...	—
Ransome's Steam Tractor ...	Ransome, Sims & Jeffries, Ipswich	—	4 15	" ...	4 " ...	—

in the furrow has a tendency to break up the soil rather than solidify it. The creeper device worked well on dry, light land, and when the plough was replaced by a cultivator the engine drew this readily through the freshly-ploughed ground without injury to the soil. At Appleby, although some time was occupied in examination and enquiries, it ploughed 1½ acres in 4 hours (double furrow).

Each of the foregoing machines is easily worked by one man; the consumption of petrol per acre varies from about 1½ gal. to 2½ gal. They can turn readily on a 4-yd. to 5-yd. headland, and appear to be better adapted than tractors for small fields, hilly land, and land on the ridge system.

Crawley's Motor Plough, also self-contained, and manipulated by one man, did excellently at Chelmsford, and attracted much attention at Cambridge, where it worked powerfully, and drew a 3-furrow plough on all the classes of soil at considerable speed. It has evidently plenty of power, and is capable of ploughing the heaviest classes of soil satisfactorily. It seems easy to control, and requires a narrow headland.

The Weeks-Dungey "Simplex" Tractor.—This is a compact machine, measuring 7 ft. 4 in. long by 4 ft. wide, and 4 ft. 9 in. high; it was generally liked at the Frithville demonstration for its compactness, and was, in fact, one of the best of the small type machines. Three speeds forward, and one reverse are provided, and, although some doubt was expressed at Frithville as to its ability to work in wet weather without slipping, the makers claim that the speed attachments overcome this difficulty. At Frithville, Appleby, Cambridge, Northants, and East Suffolk (the demonstrations in which it was tried) it did good work, and required very small headlands. Under the conditions in which it was tried, the engine was easily capable of pulling the double-furrow plough, although not so fast at Appleby as the "Bull." The machine appears useful for slow haulage work; it is said to be able to pull 5 tons on the level. Two men were required for ploughing.

The Big Bull Tractor is a 3-wheeled machine with a powerful engine, capable of pulling a 3-furrow plough; its length is 13 ft. 11 in., and height 6 ft. 3 in. The driving wheel and the single-steering wheel run in the furrow, and do not pack the land.

Some Lincolnshire farmers thought that this arrangement of the driving and steering wheels, although generally com-

mendable, might be disadvantageous under certain conditions by consolidating the furrow bottom too much; on the other hand, it was noted at Cambridge, on the heaviest part of the land, that the single-tractor wheel in the furrow seemed inclined to churn up the subsoil.

The fact of the driving wheel running in line with the steering wheel makes the tractor automatically self-steering; it only needs driving round the ends. The tractor required 2 men to handle in the demonstrations, though the makers claim that 1 man can do the work when their own plough is fitted.

At Cambridge the tractor drew a 2-furrow plough, and ploughed a greater area than any other machine, working steadily through the day. At Appleby, 3 acres of land were well ploughed 5 in. deep in 4½ hours; in a test in Lincolnshire earlier in the year, 1 acre was ploughed in 1 hr. 50 min., a little over 2 gal. of petrol being consumed. The tractor left a narrow headland at Appleby, but was not particularly handy at the headland at Cambridge.

A point which was not tested was as to whether a 3-wheeled tractor is desirable for really stiff soil. Further, in Lincoln, the question was raised as to whether a 3-wheeled tractor is equal to a 4-wheeled one for haulage purposes, but apparently the draw chain adjustment at the back permits of an even and direct pull, and the single steering wheel is no disadvantage. The question of backing the machine might be a difficulty in reaping.

A feature of the machine is the ease with which the working parts may be inspected.

The Mogul Tractor is a very powerful machine pulling a 4-furrow plough. It is started on petrol, and runs on paraffin. It has 2 speeds forward, and 1 reverse. It is easily handled, having a steering mechanism of the motor-car type; all the working parts are well protected. It was tested at Frithville, Chelmsford, Moulton (Northants), and Bramford, and did good work. On account of its heavy weight, however, the wheels are apt unduly to pack the land. It was rather slow at Frithville, and, although ploughing 4 furrows against the "Bull's" 3 furrows, it did not get over so much work as the latter. It is too heavy a machine for small occupiers, and probably too expensive for ordinary farmers. The tractor can haul 10 tons on level roads.

The Daimler Tractor is another machine which is very heavy, and expensive for ordinary farmers; the makers intend to turn out a smaller and lighter machine after the war. However, it did very satisfactory work at the Lincoln demonstrations (it was not tried elsewhere), ploughing about 1 acre per hour. It pulls a 4-furrow plough. No delivery of these tractors can be obtained at present.

The Saunderson and Mills "Universal" (Model G) Tractor was tested at Frithville, Chelmsford, and Moulton. It was regarded, both at Frithville and Chelmsford, as an exceedingly useful general-purpose machine, and it seems to be one of the best of the more expensive types. An advantage is that it works on paraffin, the consumption of which, in ploughing, was put at 3 gal. per acre at Moulton, and about 4 gal. per acre at Chelmsford. The 1915 type of machine is stated to be a great improvement on older types. At Moulton it drew a 3-furrow plough at the rate of about ¾-acre per hour. It has 3 speed gears of approximately 2, 3, and 5 miles per hour forward, and 3 reverse speeds. It will haul a load of 5 or 6 tons at the rate of 5 miles per hour, and drive a 4-ft. 6-in. threshing machine.

The very powerful *Sandusky Tractor* was tried at Frithville, and pulled a 4-furrow plough with ease; the plough was fitted with a patent lever apparatus for lifting all the ploughs out of work, and letting them in again at the headlands, which does away with the necessity of a man at the ploughs. This tractor again seems too heavy and expensive for the ordinary farmer. It did much less than 1 acre per hour at Frithville. The wheels skidded on the loose soil surface when a trial of deep ploughing (10 in.) with a 3-furrow plough was carried out.

Good work was done by the *Ivel Tractor* at Chelmsford. This tractor has been before the public for 11 years, and its merits are well known.

The *Overtime* was tried at Moulton and Bramford, its work being very favourably commented upon. It drew a 3-furrow plough with ease, but required 2 men. As a light tractor at a moderate price it appears to be one of the most useful on the market.

Ransome's Steam Tractor was tried at Bramford. The soil, though light, was somewhat soft as a result of heavy rain the day before the trial, and the tractor was unable to demonstrate its powers. On firm, level land, however, there is reason to believe that this tractor is capable of doing good work.

The *Mann Steam Tractor* pulled a 4-furrow plough at Frithville, and did good work, but it is generally held to be more adapted to road work than ploughing. However, it ploughed evenly and well, and satisfied many of the larger farmers.

THE COMPOSITION OF WOOD AND PLANT ASH.

R. A. BERRY, F.I.C., F.C.S.,

Professor of Agricultural Chemistry, West of Scotland Agricultural College, Glasgow.

IN the autumn of last year, 1914, some ash analyses were made in the chemistry department of the West of Scotland Agricultural College. The object was to determine the amount of potash in the ash of certain forest and plant produce, with a view to the utilisation of the ash as a possible source of potash. Although several articles have since appeared in this *Journal** dealing with the same subject, the results obtained might still be of some interest.

The ashes, which were obtained by arrangement with the Forestry Department of the College, may be taken as being fairly representative, and they were produced and collected under conditions in operation in practice.

The percentage of potash soluble in (*a*) strong hydrochloric acid and in (*b*) water were determined; the results are given in the following table:—

Ash.	Potash (K_2O): percentage soluble in		Percentage of "Total Potash"† soluble in water.
	Acid.	Water.	
Bracken	20·45	10·61	51·9
Spruce	11·94	8·23	68·9
Mixed forest produce	3·13	1·50	47·9
Hardwood, engine fire	10·44	6·77	64·8
Softwood, forest fire	11·79	6·53	55·4
Hardwood, largely oak trimmings	3·53	2·75	77·9
Flue dust from blast furnaces:			
No. 1	3·75	2·13	56·8
No. 2	3·93	2·64	67·2

Considered from the point of view of the total potash content it is clear that four of the ashes could quite well be used as a

* E. J. Russell, *Jour. Bd. Agric.*, Vol. xxi., No. 8, November, 1914.
C. T. Gimingham, *Jour. Bd. Agric.*, Vol. xxii., No. 2, May, 1915.
E. J. Russell, *Jour. Bd. Agric.*, Vol. xxii., No. 5, August, 1915.

† Total Potash = Potash soluble in strong hydrochloric acid.

potash manure in place of a low grade potash salt such as kainit, which contains 12·4 per cent. of potash. Indeed, on a valuation of the bracken ash on the basis of the potash soluble in strong acid, and taking the price per unit of potash previous to the war at 4s., the value of this ash would work out at about £4 per ton, whilst several of the other ashes would be worth about one half of this figure. Valued according to the current market price per unit of potash the price per ton would be considerably higher.

On the other hand, not much more than one half of the total potash is soluble in water, the soluble potash salt being mostly the carbonate of potash, so that it would appear questionable to value the ashes for manurial purposes on the basis of the total potash content only, whilst a valuation based upon the water soluble potash might give a low estimate of their true value.

Some of the ashes contain appreciable quantities of phosphates, which must be taken into account in judging the ashes for manurial purposes. The percentages of phosphates and other constituents are given in the following table :—

Ash.	Phosphoric acid expressed as		Lime. CaO.	Magnesia. MgO.	Manganese oxide. MnO.
	P_2O_5.	$Ca_3(PO_4)_2$			
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Bracken	3·37	7·35	10·90	3·69	0·84
Spruce	7·01	15·30	28·20	2·90	1·35
Mixed forest produce	1·54	3·36	12·40	2·03	0·47
Hardwood, engine fire	5·02	10·95	44·70	4·71	2·23
Softwood, forest fire	5·23	11·41	25·20	3·80	2·14

The phosphates present are practically all insoluble in water and are mostly in the form of calcium and magnesium phosphates. Their value for manurial purposes should be much the same as the value of the phosphates in steamed bone flour. Their presence in such relatively large amounts adds, of course, considerably to the value of the ash. The other constituents given in the table are, perhaps, of small interest only.

When the material is properly burnt, the ashes are bulky and of a light friable and powdery nature, generally grey in colour. If necessary they should be passed through a sieve of $\frac{3}{16}$-in. mesh, to get rid of stones and unburnt material. They must be protected from rain, otherwise the soluble potash salts

might all be dissolved out and lost. They are strongly alkaline and, wheu mixed with ammonia salts, liberate the ammonia freely, more especially if the ashes are damp; otherwise, with the exception of ammonia salts, ashes form a suitable medium for mixing with most manures. They must be stored in a dry place.

As the value of the ashes is judged by the amount of potash and phosphates which they contain, the following table may be useful for the purpose of comparison :—

Ash.	Total potash. K_2O.	*Percentage* of total potash soluble in water.	Phosphate of lime. $Ca_3(PO_4)_2$
	Per cent.	Per cent.	Per cent.
Bracken	20·45	51·9	7·35
Spruce	11·94	68·9	15·30
Mixed forest produce	3·13	47·9	3·36
Hardwood, engine fire	10·44	64·8	10·95
Softwood, forest fire	11·79	55·4	11·41
Hardwood, largely oak trimmings	3·53	77·9	2·40
Flue dust from blast furnaces :—			
No. 1	3·75	56·8	Not ascertained.
No. 2	3·93	67·2	

Apart from the chemical content, the economic importance of the ashes at the present time will depend upon the quantities available. The results of some recent investigations* given below will throw some light on this point.

1. From the "lop and top," undergrowth, weed growth, and litter in any average type of woodland, about ½ ton of ash is produced per acre.

2. From portable saw mills and foreign timber mills, where wood constitutes the fuel, about ¼ cwt. of ash per day is obtained as a by-product.

3. Ten acres of fully-stocked bracken land is found to produce 1 ton of ash, the quantity being dependent upon the density of the crop.

CALF REARING.

THE need for more stores has been keenly felt for many years by farmers engaged in fattening cattle for the butcher, and, even before the outbreak of war, store cattle were making very satisfactory prices. Raisers of cattle are now getting their full share of the high prices at which beef is selling, and cattle breeding is meantime a profitable business.

There is a similar demand for good heifers, and dairy farmers are paying high prices for heifers and young cows.

In these circumstances, and also from the point of view of the country's needs, it is very desirable that a sustained effort should be made to increase the numbers, and maintain and, if possible, improve the quality and usefulness of home-fed cattle. While it is true that the scarcity of labour is pressing heavily on many farmers at the present time, the fact should not be overlooked that calf-rearing may be carried on successfully, perhaps most successfully in many cases, during the winter months when work in the fields is relatively slack, and that calves may be tended by old men, intelligent lads, and women. Further, calves can often be reared with a minimum of labour and trouble—important considerations at the present juncture when farmers are starting calf-rearing for the first time and when labour is scarce. In this connection the attention of readers is specially directed to an experiment recently conducted at Woburn for the Royal Agricultural Society of England and referred to later. While, therefore, it should be the aim of feeders and dairymen to rear at least a proportion of the animals they require, it is probably to occupants of the smaller holdings, to farmers of upland or other grass land unsuited to cultivation, to owners of private parks, and, generally, to those who already rear a few calves, that the nation must look for the greatest extension of calf-rearing.

Methods of Calf Rearing.

The particular method adopted depends largely upon the system of farming practised. In this leaflet four methods, more or less distinct, are discussed under the following heads :—

1. Upland Grass Land.
2. Cattle-feeding Districts.
3. Milk-selling and Cheese-making Farms.
4. Butter-making Farms.

The care of the calf in early life is described fully in Leaflet No. 142 (*Calf Rearing*), and Leaflet No. 272 (*Supply of Store Cattle and Slaughter of Young Calves*), but the following general recommendations may be given :—

(1) There should be a plentiful supply of clean straw immediately behind the cow for the reception of the calf at birth.

(2) The navel cord should be rubbed at once with an antiseptic, *e.g.*, a lump of "bluestone" (copper sulphate), as

a precaution against infection. (Bluestone has the effect of causing the cord quickly to shrivel up.)

(3) The calf should receive the first-drawn milk of the cow—colostrum—the special nutritive and laxative properties of which are irreplaceable.

(4) It is essential to avoid giving too much food at one meal, especially after a fast, *e.g.*, when calves are purchased at a distant market.

(5) For the first three weeks the calf should be fed at least three times daily, with from 3 pts. to 2 qts. of milk at a meal; afterwards two feeds at equal intervals will be sufficient.

(6) All changes in diet should be effected gradually.

(7) All utensils should be kept scrupulously clean and the milk should be fed sweet and as near blood heat (about 101° F.) as possible.

(8) The calves should be housed in comfortable quarters with access to plenty of fresh air and sunshine. A cement floor, however suitable from the sanitary point of view, is too cold unless covered with several inches of peat moss or straw litter. A floor formed of either bricks, or earth, or rammed chalk is preferable. No stereotyped set of buildings is required. If the existing buildings are not quite suitable a little adaptation will usually suffice.

(9) A dose of castor oil should be given on the first appearance of digestive trouble. Mild cases may be cured by the addition of a little lime water, or a pinch of bicarbonate of soda, to the milk.

(10) Above all, every effort should be made to secure healthy calves of right type and breeding.

1. *Upland Grass Land.*

On upland farms in the South of Scotland and North of England, where plenty of cheap grass is available, cows are often allowed to rear their own calves. Such a method obviously saves labour, but is profitable only when the stock are of first-class quality and can be kept throughout the year at little expense, or when the sale of milk and its products is not the primary consideration. Galloway cows are crossed with a white Shorthorn bull with the object of producing blue-grey calves about the month of April. The calves run out at grass with their dams and are weaned about the end of October; afterwards the cows remain out of doors till Christmas, or even throughout the winter if provided with some form of shelter.

In other cases Angus cows are housed and calved down in sheltered yards and turned out to grass with their calves in spring, while in districts where the grass is of somewhat better quality, cows or heifers of Shorthorn breeding crossed with an Angus bull will rear their own and another calf in the course of the summer.

Calves thus reared are admirably adapted for the production of "baby beef" and usually command top prices when sold either as weaned calves or as stores or butcher beasts at from one to two years old.

For the production of dairy stock parents with a "milk pedigree" should be used.

2. *Cattle-feeding Districts.*

In non-dairying districts where the grass is of good quality, and winter keep can be grown cheaply, three or even more calves per cow, per annum, may be reared, according to the milk-yielding capacity of the cow. Under this system the best results are obtained when the cow calves in the early winter. Milk can be used most economically when hand-feeding is practised, but where this is impracticable the cow's own calf and another are put on to suck three times a day. In the intervals between meals they should be kept tied up near the cow or turned loose in an adjoining box. Preferably for the first month or so calves should be tied up; afterwards, when they have developed the power to ruminate and are less likely to suck each other, they may be turned, a few together, in a loose box, and be given some crushed oats or maize, linseed cake and bran together with some "fingered" roots and well-got hay. At the end of about 4 months the calves may be weaned and, if the weather is suitable, turned out to grass. The cow may then be given another calf, or two if she is a good milker, and be brought in from grass three times at first and later twice a day for suckling. On the whole foster calves are likely to do best when penned up and the cow is brought home for them to suck. They should have, however, the run of an open yard and be supplied with green food.

Cows calving in winter are likely to yield most milk in the course of a year, as the flush of the grass in spring and early summer tends to prolong the period of lactation. Where plenty of roots or other succulent food and good straw are available in winter, a cow, suckling two calves, should not require more than 2 lb. to 3 lb. of cake or meal daily in addition.

Where, however, winter keep is scarce, it will be better to let the cows calve down in April, milk each cow and distribute the milk among several calves, or, where this is impracticable, put two calves on to suck. The first couple may be weaned in due course and replaced by two more. With access to pasture during the winter, the cow should require little beyond some hay or straw and roots.

Calf-rearing on the lines described is peculiarly adapted to the circumstances of the small holder. Where close personal attention, either on the part of the owner or a member of his family, can be given, it is not unusual for as many as eight or nine calves per annum to be reared on a single good-milking cow. In such cases the usual procedure is to allow successive pairs of calves to suck the cow for about two months, during which time they have been taught to lick up meals from a trough and nibble at roots or grass.

A restive cow may usually be controlled by haltering and tying to the fodder-rack overhead, or by passing a rope tightly round her body immediately behind the shoulder.

3. *Milk-selling and Cheese-making Farms.*

On dairy farms, where the milk is sold or made into cheese, few calves other than heifer calves from the best-milking cows are reared. In view of the price obtainable for both milk and cheese, the ideal in these cases would be to rear on a milk substitute. Unfortunately, both experience and experiments show that to eliminate milk altogether in rearing is extremely undesirable, if not practically impossible. Much, however, may be done with a little milk judiciously supplemented with other foods. For the first three or four weeks a calf should receive, if it can possibly be arranged, only whole milk—about 1 gal. a day on the average. For the next three or four weeks, 5 pts. or 6 pts. of milk, daily, diluted with water or skim-milk, should be given, together with dry trough feed, such as equal parts of crushed oats or maize, linseed cake and bran, and, as soon as the calf will eat it, a little succulent food in the shape of "fingered" roots or grass. A calf may be quickly induced to lick up meal from a trough if a little be placed in its mouth immediately after drinking.

In trials conducted at Garforth* (Leeds University Experimental Farm), the following milk substitute proved quite satisfactory :—

Ground linseed	1 part.
Ground malt	3 parts.
Pea meal	6 ,,

* Paper on "The Rearing of Calves," read by Professor Seton at a meeting of the Farmers' Club, December, 1913.

The mixture was scalded and then reduced to the proper temperature (about 100° F.) with cold water. The substitute very gradually replaced the milk, and at the end of about one month, when the milk was entirely withdrawn, each calf was getting 18 oz. of the mixture per day. This was ultimately increased to a maximum of 2 lb. per calf per day, at which amount it remained till the calves were weaned at about six months old. The quantity of liquid, throughout, was 1½ gal. per calf per day.

Mr. W. T. Lawrence, of Newton Rigg, has used the following mixtures with success :—

No. 1.—Used for each calf when a small quantity of skimmed or separated milk is available :—

8 parts of oatmeal (by weight).
1 part of ground linseed.

Scald 2¼ lb. over night with 5 pts. of boiling water, boil for 10 minutes next morning, and add 5 pts. of separated milk with about ¼ oz. of salt and 2 oz. of sugar.

No. 2.—When no skimmed or separated milk is available :—

2 parts linseed cake meal.
2 ,, oatmeal.
1 part ground linseed.

Mix 3 lb. with 5 qts. of boiling water over night, and boil for 10 minutes next morning ; add salt and sugar as with No. 1.

No. 3.—Requiring no boiling :—

14 parts linseed cake meal.
5 ,, ground linseed.
2 ,, wheat flour.
2 ,, locust-bean meal.

Mix 3 lb. with 5 qts. of boiling water and a sprinkling of salt.

Where No. 2 or No. 3 is used, it is introduced very gradually thus :—

First Week.—Mother's milk only.

Second and Third Weeks.—3 pts. of new milk and 1 pt. of the gruel at each of three meals.

Fourth and Fifth Weeks.—2 pts. of new milk and 2 pts. of gruel.

Sixth and Seventh Weeks.—1 pt. of new milk and 3 pts. of gruel.

Eighth Week.—2 qts. of gruel and no new milk.

Hay is given at the fifth week.

NOTE.—In preparing linseed for calves it should be boiled with water or very thoroughly scalded. If merely soaked in water (cold or warm) the conditions favour the production of a poison—prussic acid—sometimes latent, in small quantities, in samples of linseed. On the other hand, if fed whole or simply crushed, there is no risk of poison forming.

On cheese-making farms in Cheshire the following method* of rearing calves is successfully practised.

"Directly the whey is run from the curd, it is put into a large copper, and then heated over a quick fire. The

* Paper on "The Rearing of Calves," read by Professor Seton at a meeting of the Farmers' Club, December, 1913.

albumen coagulates, and, just before boiling point, rises to the top in flakes, known as "fleetings." These are skimmed off as they rise. The whey must on no account be allowed to boil, or the "fleetings" will sink to the bottom. To assist them to come it is often helpful to add 2 qts. or 3 qts. of cold whey. This also checks the bulk from boiling.

The boiler must be thoroughly cleaned out each day after use, and for this purpose a soft brick or rubbing stone is best. The calves are fed twice a day as follows :—

1st week—4 qts. milk per day.
2nd „ —6 „ milk per day.
3rd „ —6 „ —half milk and half "fleetings" per day.
4th „ —8 „ —2 qts. milk and 6 qts. "fleetings" per day.
5th „ —8 „ —1 qt. milk and 7 qts. "fleetings" per day.
6th „ —8 „ "fleetings" per day.

Milk is rarely given after the calves are six weeks old. As soon as possible a little soft or meadow hay is given to the calves, and when about a week old a little bran as trough food. When the calves are six weeks old, and are getting no new milk, a little linseed cake and kibbled oats in equal proportions are added to the bran. Each calf is allowed about ½ lb. of the mixture. This is gradually increased to about 1 lb. per calf per day. The calves are put out to pasture when they are finally weaned (about five months old), generally about the second week in June. The quantity of "fleetings" is gradually reduced, and in the last week only one feed per day is given. The weaning process extends over two weeks. If the weather is very wet or cold, the calves are brought in for a few nights, and get a little corn and cake, otherwise they are left out at pasture for about three months, and are entirely dependent upon the grass."

Whey is not well adapted for calf-rearing, for the casein as well as the fat of the milk has been removed in the making of the cheese. Calves, however, fed on whole milk for the first month have been found to thrive well subsequently on about 1½ gal. of warmed whey daily, together with crushed oats or maize given dry.

On most cheese-making farms, a certain amount of milk will be available in the winter months before cheese-making begins, which might be distributed judiciously among a number of calves during the first month or so of their existence.

4. *Butter-making Farms.*

Where butter is made, skimmed or separated milk is usually available for calf-rearing, and, in the absence of whole milk, there is no better basis for a calf food. The essential difference between whole milk and separated milk is that the latter

has been almost entirely deprived of its butter-fat or cream. In other respects the two are practically identical. In using separated milk therefore, the aim obviously should be to replace as much as possible of the fat removed by another fat possessing similar properties. Cod-liver oil and a form of dripping obtainable from large slaughter houses, as well as other oils or fats, have been used successfully in this connection, the usual allowance being from 2 oz. to 4 oz. per head, along with 1½ gal. of separated milk. Hand-skimmed milk contains more fat than separated milk and has been used alone for calf rearing, more or less successfully. A great drawback to its use, however. is the difficulty of preserving it fresh, and sour milk is prejudicial to young calves. Various meals are used as cream substitutes: of these one of the simplest and most wholesome is ground linseed. Whole linseed and maize meal in the proportion of 7 to 1 are run together through a grinding mill. (The maize meal serves the double purpose of preventing clogging of the mill and checking looseness of the bowels in the calf.) The meal i scalded and stirred with boiling water at the rate of 1 qt. of meal to 1 gal. of water: 1 pt. of this porridge is used to 4 pts. of separated milk.

The calf dietary for the first six months as above described may be tabulated as follows:—

First week.—Its own mother's milk three times a day, commencing with about 1 qt. and increasing to 2 qts. at each meal by the third day.

Second week.—2 qts. of new milk (not necessarily its own mother's) three times a day.

Third week.—2 pts. of new and 3 pts. of skimmed (or separated) milk, with ½ pt. of linseed porridge or half a tablespoonful of cod-liver oil, three times a day

Fifth week—3 qts. of skimmed milk, with 1 pt. of linseed porridge, or one tablespoonful of cod-liver oil three times a day, and a little sweet meadow hay.

Ninth week.—Mid-day milk and cream substitute omitted. 5 qts. of separated milk are given morning and evening, a handful of broken linseed cake (6 oz.) at mid-day, and hay.

Thirteenth week.—Milk as before, ¾ lb. mixed linseed cake and crushed oats, a few pounds pulped swedes (greenmeat in summer), gradually increasing, hay *ad lib.*

Twenty-first week.—Milk as before, 1 lb. of mixed linseed cake and meal, increasing quantities of roots, hay *ad lib.*

Twenty-fourth week.—Evening milk is discontinued.

Twenty-seventh week.—Milk altogether discontinued.

Separated milk should be poured into the calf pail clear of the froth.

Much of the time and trouble involved in making porridge and cleansing utensils is obviated by the use of cod-liver oil and other fat. It is necessary, however, to see that the oil is perfectly wholesome. In American experiments, very

good results have been obtained by feeding meals in the dry condition along with separated milk.

Crushed oats and separated milk appear to make an excellent diet for calves of from 4 to 12 weeks old. In an experiment at the Royal Agricultural Society's farm at Woburn the calves, up to the age of 3 to 4 weeks, received whole milk—about 1 gal. per head daily, on the average—and nothing else. Thereafter they were given, in addition to the milk, dry crushed oats as they would eat them, a handful at a time. For the first six days the calves each ate ¼ lb. oats and drank 1¼ gal. of whole milk. The whole milk was then gradually replaced by separated milk and the oats were increased to ½ lb. daily. After 24 days the whole milk was dropped entirely and 1½ gal. separated milk and 1 lb. oats were given daily. This feeding was continued till the calves were 12 weeks old. Within a week afterwards milk was given up, but the calves continued to receive oats, together with linseed cake and hay, and were turned out to grass. During the 9 weeks of experimental treatment the calves increased in weight at the rate of almost 2 lb. per head per day.

The fact that starch in food is digested only after it has been converted into sugar in its passage through the alimentary tract, probably explains, to some extent, why starchy food, such as oats or maize give better results when fed dry than when gulped down with milk. The conversion of starch into sugar is effected largely by the saliva in the mouth, and the more slowly and thoroughly a starchy food such as oats or maize is chewed and mixed with saliva the greater is the proportion of starch that will be converted into sugar. Of course, in addition to starch, these grains contain quite appreciable quantities of oil and albuminoids. In 1 lb. of oats, however, there is only about 1 oz. of fat, whereas in 1½ gal. of whole milk there should be about 8 oz. It would appear, therefore, that in the feeding of calves, as with other animals, fat, to some extent at least, can be replaced by starch.

Careful attention during weaning is all important. On no account should the calves be allowed to lose condition. If at grass they should be housed early in autumn with a view to preventing Husk or Hoose, and the feeding should be such as to encourage uninterrupted progress. For particulars of suitable rations for young cattle readers are referred to the notes on feeding stuffs which appear monthly in the Board's *Journal*.*

* Reprints of these notes may be obtained free of charge on application to the Board.

TOP-DRESSING WHEAT IN AUTUMN.

As a means of increasing the supply of home-grown wheat, a return to the old practice of top-dressing the wheat crop with nitrogenous manures in autumn may be recommended.

Increase Produced by Top-dressing.—Long ago, Lawes and Gilbert, as the result of their first twenty years' experience at Rothamsted, came to the conclusion that with land of poor or moderate quality an increase of from 5 to 6 bush. of wheat per acre might be expected from the application of 1 cwt. of sulphate of ammonia in autumn. This conclusion had reference to quantities of 43 and 86 lb. of nitrogen per acre (equal to the amounts present in dressings of 2 cwt. to 4 cwt. sulphate of ammonia) and to soils which, without a nitrogenous manure were capable of yielding from 18 to 28 bush. of wheat per acre. In this *Journal* for September, 1915, Dr. E. J. Russell, Director of the Rothamsted Experimental Station, pointed out that for the long period of 61 years a dressing of ammonia salts equal to about 2 cwt. sulphate of ammonia has increased the wheat crop by 8·7 bush., and that double the dressing has produced 17·6 bush. increase; this increase is at the rate of nearly 4½ bush. of wheat per cwt. of sulphate of ammonia.

For reasons which need not be discussed here, there have been very few experiments on the autumn top-dressing of wheat, and there is no extensive series of tests on land under ordinary rotation by which we can check these estimates based on the permanent wheat plots at Rothamsted.

The experiments at Rothamsted may, however, be accepted as sufficient to establish the following proposition. *If prudence be exercised in applying nitrogenous manures, so that they are used on suitable soils and at the proper times, there is good reason to anticipate an increase of one sack (240 lb.) of wheat per acre as the result of an application of* 1 *cwt. sulphate of ammonia in the late autumn, and a further increase of one sack per acre as the result of an application of* 1 *cwt. sulphate of ammonia or* 1⅓ *cwt. nitrate of soda in spring.* So great an increase could not be expected from wheat land of high quality yielding in an ordinary year without direct manuring 40 bush. per acre and over; neither could this increase be expected on light land unsuited to wheat unless the season proved unusually favourable (dry from December to March, and moist from April to June), nor could the increase be expected on neglected land full of couch and bent grasses.

There are now 2,000,000 acres under wheat in this country, and assuming that the crops on about 1,000,000 acres are

suitable for top-dressing, and that the season proves moderately favourable, the application of nitrogenous manures as above described would result in the addition to the 1916 crop of 1,000,000 qr. of wheat. This increase of home-grown food requires scarcely any effort; the labour involved in top-dressing is trifling, and is more than saved later in the year, since top-dressed crops are likely to smother annual weeds.

If dressings of 2–2½ cwt. per acre of a nitrogenous manure, partly in autumn and partly in spring, are applied with discretion, the profits should be substantial, and at the worst, in the event of the coming harvest year proving to be very unfavourable, there is not likely to be any considerable loss from following the policy advocated, unless the manure is used with lack of judgment and rich loamy soils are over-dressed so that the crops become laid badly in June.

Autumn v. *Spring Top-dressing.*—In ordinary circumstances, when applying small dressings of ¾ cwt. to 1 cwt. per acre of a nitrogenous manure, the best results on the average are got from spring top-dressings, and these are almost universally recommended. But where the nation's interests require patriotic farmers to grow the largest crops that their fields can produce, autumn as well as spring manuring is called for, and the Board, therefore, recommend that for the crop of 1916 from one-third to one-half of the total dressing of nitrogenous manure should be applied in the late autumn, and the remainder in the spring.

Formerly, sulphate of ammonia was usually applied for wheat in the autumn because it was thought that the soil fixed this manure and prevented loss by drainage; but about 35 years ago it was shown at Rothamsted that the ammonia quickly changed into nitrates in the soil, and that a good deal of what was applied in the autumn might be washed out during the winter (Lawes and Gilbert remarked at the time, that in spite of losses the autumn dressings did much good). Recent experience at Rothamsted has shown that in dry years an autumn application is best and in wet years a spring dressing. On the average as between autumn and spring the latter has a substantial advantage, but when the period December to March has been moderately dry and mild, and the early summer dry and cold, autumn manuring has been proved to be much the more effective.

Keep the Wheat Plant Growing.—A forecast of the season cannot be made, but a study of the effects of weather on field crops and of the influence of past seasons on the yield of wheat

furnishes hints for those who are endeavouring to grow a heavy crop in 1916. An examination of the Rothamsted records shows that the finest wheat crop ever grown there was that of the year 1863. The character of the weather of this harvest year was: November cold and dry, December and January mild and moderately moist, February and March mild and dry, April very dry and warm, May and June cool with a sufficiency of rain, and July dry and bright. Commenting on this wonderful wheat crop, Lawes and Gilbert say: "the extraordinary result was due to the almost unchecked growth from the first appearance of the plant above ground up to the time of harvest rather than to any extraordinary characteristics of the season." This statement supplies a hint for the farmer who desires to produce a bumper crop of wheat; it is obvious that in 1916 "keep the plant growing" should be his maxim.

Critical Periods in Winter and Late Spring.—If growing wheat crops are watched, or the records of seasons are studied, it will be remarked that there are two critical periods in the early development of the young wheat plant, viz.: the period from Christmas to about the end of February, when it is struggling in a wet soil, and the period in April and May when, if badly rooted, it may be greatly injured by drought. The purpose of an autumn top-dressing is to supply the struggling plant with food in the period from Christmas to March so that it may develop roots and make some growth when the weather is mild. An autumn application of manure is more subject to loss in the drainage water than a spring application, but, unless the season is quite exceptionally bad, the manure will benefit the plant in spite of the losses through drainage. The washing downwards of a nitrogenous dressing during winter and spring has even some advantages, since roots follow manure and deep rooting is thereby encouraged. If a cold and dry April and May follow a mild and fairly dry early spring the value of an autumn top-dressing of sulphate of ammonia may be very marked indeed.

Time to Apply Sulphate of Ammonia in Autumn.—The usual practice is to apply late in October or early in November; but it is doubtful if this is the best time for general application. In the early autumn the earth is warm, and in most cases the young wheat plant has no difficulty in meeting its needs from the nitrogen of the soil. In poor and cold soils where the wheat plant is backward, it would probably be advisable to top-dress in November. If the young plant is growing well, however, it will be better to keep back the top-dressing until December. Recent work at Rothamsted has shown that,

given open weather, nitrification (that is the change of ammonia into nitrate, the substance upon which the plant feeds) proceeds during the winter to a greater extent than was formerly supposed; although the change becomes very slow below 40° F., nitrification goes on in any part of the soil not actually frozen. Given ordinary winter weather, manure intended to help the crop through the first three months of the year may be applied up to about 1st January. The objection to applying sulphate of ammonia early in the autumn is that spells of very wet weather often occur between the middle of November and the middle of December, and if there were a heavy fall of rain while the soil is still warm, much of the manure may be washed out before the plant requires it. Later on, when the soil gets colder, the danger of loss is much reduced.

Recommendations.—The following suggestions are made for the guidance of those who intend to use sulphate of ammonia during the autumn. The quantities of manure given are for one acre of land :—

1. Rich loams, highly manured clay soils, or good fen soils likely to grow 40 bush. of dressed wheat and over in an ordinary season need have no autumn top-dressing.

2. All ordinary clay soils likely in an ordinary year to produce 32 to 40 bush. of wheat, on which the young plant is in fair condition, should get from ¾ to 1 cwt. sulphate of ammonia about the middle of December.

3. Similar soils on which the young crop is poor and backward should get ½ cwt. sulphate of ammonia in the middle of November and ½ to ¾ cwt. towards the end of December.

4. Poor clay soil producing 24 to 32 bush. in ordinary years should get ¾ cwt. sulphate of ammonia and 3 cwt. superphosphate of lime in the middle of November and ¾ cwt. sulphate of ammonia about the end of December.

5. Good soils of medium texture producing 30–40 bush. in ordinary years should get 1 cwt. sulphate of ammonia about the middle of December.

6. Poor soils of medium texture producing 20–30 bush. in ordinary years should get ½–¾ cwt. sulphate of ammonia and 3 cwt. superphosphate in the middle of November and ¾ cwt. sulphate of ammonia about Christmas.

Through the Sulphate of Ammonia Association the Board have made arrangements by which manufacturers of sulphate of ammonia will reserve a supply of manure for autumn top-dressing. This supply will be sold during November and December at prices not exceeding £14 10s. net cash per ton f.o.r. at the maker's works, in bags, in lots of 10 cwt. and upwards.

Farmers are recommended to purchase early for, if the demand proves to be greater than anticipated, and the reserved stock is sold out, current market prices must be paid.

The President of the Board has appointed a Committee to make arrangements for the supply of fertilisers. Farmers who have any difficulty in securing supplies of sulphate of ammonia at the prices stated should communicate at once with—*The Secretary, Board of Agriculture and Fisheries (Fertilisers Committee), 3, St. James's Square, London, S.W.*

TRANSPORT OF AGRICULTURAL PRODUCE.

How can growers economise in the transport of produce by rail and promote safe and rapid delivery?

Several of the railway companies have now on sale, at all of their stations from which produce is forwarded, light and cheap boxes. The Great Western Railway Company and the South Eastern and Chatham Railway Company supply boxes as under :—

	G.W.R.			S.E.C.R.			
	Length, in.	Breadth, in.	Depth, in.	Length, in.	Breadth, in.	Depth, in.	Price, each.
No. 1..	10¾ ×	7½ ×	3	10¾ ×	7½ ×	3	2½*d.*
„ 2..	13 ×	9 ×	4½	13 ×	9 ×	4½	3*d.*
„ 3..	15¾ ×	10¾ ×	5	15¼ ×	10¾ ×	5	3½*d.*
„ 4..	16¾ ×	11¼ ×	5½	16¾ ×	11½ ×	5½	4*d.*
„ 5..	18½ ×	13 ×	6	18½ ×	13 ×	6	5*d.*
„ 6..	21¾ ×	15 ×	7	21¾ ×	14 ×	7	6*d.*

The inconvenience of returning empty packages may be avoided by the use of these boxes.

Damage in Transit.

When certain kinds of agricultural machines and implements are carried by the railway companies at the owner's risk and are damaged in transit, they may be returned to the senders for replacement *free of charge for carriage,* provided they are returned within two weeks from the date of being tendered by advice or otherwise.

This concession applies to agricultural carts and wagons; chaff cutters; corn crushers; oil-cake mills; root cutters and pulpers; and other machines for preparing food for agricultural purposes. It does not apply to iron harrows land rollers; clod crushers; horse gearing machinery steam engines, portable, vertical, or horizontal, in lots under 1 ton; vegetable washing machines.

Cartage Rebates.

Certain rates called "Collected and Delivered" or "C. & D." rates include charges for cartage to and from the stations. Where goods consigned at these rates are carted at either end of the journey by the consignor or consignee an allowance known as a cartage rebate becomes due from the railway company, and may be obtained on application by the person who has paid the rate.

Packing and Despatch.

Great care should be given to packing. If through being insecurely fastened a package comes open in transit, the railway company may contend that any loss that may result is due to defective packing, and that, therefore, they are not liable. If boxes are used they should be secured by nails and not by rope or cord. The reason is that it is difficult to remove the contents of boxes which have been nailed up without leaving evidence of pilfering, and where such evidence exists railway companies are generally prepared to pay compensation, even though the goods were carried at owner's risk.

Addressing.

Much delay and loss is caused by failure to address consignments sufficiently and to send them to the station in time to be loaded before the train is due to start. Consignors should remember that an address which is legible to themselves is not always legible to other people, and that the late arrival of their goods at the station may cause loss not only to themselves, but also to their neighbours, whose consignments may be carried by the same train.

Where to Enquire.

Most of the railway companies have special literature on this subject, and this will be sent on receipt of an application to the General Manager of the company concerned.

"Bulking."

The "bulking" system is recommended as a means of effecting a considerable saving in the cost of conveyance of goods, both as regards sales and purchases.

The following are the railway rates for the conveyance of plums from the Vale of Evesham to London:—

Small lots, per ton.	10-cwt. lots, per ton.	1-ton lots, per ton.	2-ton lots, per ton.	3-ton lots, per ton.
£ s. d. 1 8 0	£ s. d. 1 3 10	£ s. d. 1 2 1	£ s. d. 1 0 10	£ s. d. 1 0 4

Much higher rates, however, may be legally charged under the "small scale for lots under 3 cwt." The railway company's charges, for instance, for the conveyance of three small lots of plums from Evesham to London are as follows:—

cwt.	qr.	lb.		s.	d.
0	2	0	.. ..	1	3
1	0	0	.. ..	1	11
1	2	0	.. ..	2	8

Assuming that ten Evesham fruit-growers, each having 1 cwt. of plums to send to London, agreed to bulk their several lots and forward them as one consignment, the railway company is bound to calculate the carriage in this way:—

cwt.	qr.	lb.		s.	d.
10	0	0	@ 23s. 10*d.* per ton ..	11	11

The cost of conveyance of each lot would then be just under 1*s.* 2½*d.* as against 1*s.* 11*d.* if sent as a single parcel. The more lots there are in the consignment the better it will be for each individual, because, as the weight increases, the rate decreases *pro rata.*

Take another example. The rates for apples and pears between Evesham and London are:—

Small lots, per ton.	10-cwt. lots, per ton.	1-ton lots, per ton.	2-ton lots, per ton.	3-ton lots, per ton.
£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1 3 2	0 18 0	0 17 4	0 16 6	0 16 0

The cost of conveyance of a consignment of apples weighing, *say, 2 cwt. (on the "Small's" scale) would be 2s. 9d.; but* if twenty such lots were bulked and sent forward as one lot, the carriage would be charged at 16*s.* 6*d.* per ton; total, 33*s.*, or 1*s.* 8*d.* per 2-cwt. lot. ***There would be, therefore, a saving of* 1*s.* 1*d.* *in the carriage of each consignment.***

This method of consigning can be employed with equally beneficial results in any district, and in connection with the carriage of many kinds of agricultural produce and requisites. Growers should take care to inform themselves on the position.

The system has its limitations. For example, when consignments destined for a number of consignees are aggregated it may be that the extra cost of delivery is in excess of the gain derived from the cheaper rate. It is necessary, therefore, that senders should consider in each case the advantages and disadvantages of the various methods of consignment open to them.

CO-OPERATIVE FARM IMPLEMENT SOCIETIES (*continued.*)

T. WIBBERLEY, N.D.A., N.D.D.,
Agricultural Expert to the Irish Agricultural Organisation Society.

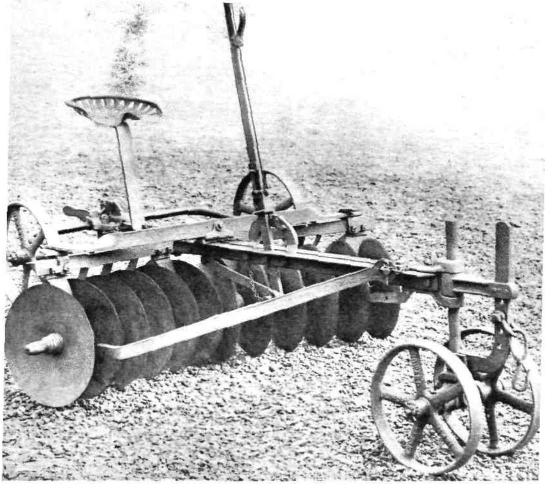
Cultivating Implements.

OF all the agricultural implements which have been invented during the past generation, it is doubtful if there is one more useful than the disc harrow. The term harrow applied to this implement is a mis-description. The machine is really a combination of a plough and a pulverising cultivator. As will be seen from the illustration the implement consists of two sets of concave discs, fitted on a central axle. As the implement is moved the discs revolve, inverting and breaking up the soil at the one operation. The two sets of discs are controlled by a lever, and the more forward this lever is pushed the greater the angle at which the discs run to the line of draught, and the deeper they cut into the soil. Deeper work is also obtained on those machines fitted with a swivel and adjustable front by elevating the front of the machine, lowering the draught, and also by hanging weights on the axle of the transport wheels at the back.

Disc harrows are divided into two chief classes, viz., horse discs and motor discs, which may be described under separate heads. Before giving these descriptions, however, it will be of interest to describe the varied use and capabilities of disc harrows.

Generally speaking it is no exaggeration to say that with the exception of very light or stony land, the introduction of the disc harrow reduces the labour, time, and cost of cultivation by 50 per cent. For example, on stubble land where, in order to prepare it for a root crop, it is customary to plough, cultivate once or twice, and sometimes also cross plough, one ploughing followed by a disc harrowing in both directions generally suffices to bring the soil into a fine enough state for drilling. Before drilling, however, it is necessary to level the land with a spring-tooth harrow as the disc leaves the land in ridges. Even on very heavy clays, the writer has found that one ploughing is all that is required for a drill crop, provided that the stubble is double disc harrowed both before and after ploughing.

A statement which will give the practical farmer a better idea of the economy effected by a disc harrow is that a double disc harrowing of an acre of land can be carried out



hree-Horse Disc Harrow with Swivel Front and Fore Carriage. Also suitable for a 10-B.H.P. Tractor.

with one man and a team of three horses in from 1½ to 2 hours. Double disc harrowing is best performed by working the land in "setts" as in ploughing, so that the near or "off" set of discs half overlaps the stroke made on the previous journey. This will mean that the piece of land which was disc harrowed by the left or "off" side of the machine in number one stroke will be cut in the opposite direction by the right or "near" side of the machine in number two stroke and, as a result, will be more completely pulverised.

It is also very useful to know that the disc harrow works all the better when the land is firm, so that in tilling cloddy land it is often a great advantage to roll the land before discing.

In the tilling of medium stubbles for roots, providing the land is fairly clean, the writer often dispenses entirely with ploughing. This is accomplished by several disc harrowings in *both directions, alternating every stroke of the disc with* a strong cultivator. By this means such a soil can be worked to a depth of 6 in. or 7 in., the spring-tooth harrow and roller being, of course, used in securing a fine tilth before drilling. This method is also followed in tilling a corn stubble for a crop of tares, and in tilling a tare stubble for a crop of giant rape or other type of winter greens. The entire cultivation of an acre of land in the above manner with either three horses or a light motor, takes from 5 to 8 hours. One great feature of quick cultivation, which is worth keeping in mind, is that it helps the conservation of soil moisture. The advantage thus derived is most pronounced in the autumn and summer tillage, which is necessary in the case of tares and winter greens respectively.

The Discing of Lea Land.—It is in the tilling of lea land for a drill crop that a disc harrow shows to the greatest advantage. In progressive potato-growing districts it is well known that the best crop from the standpoint both of quality and quantity can be obtained from the lea. The difficulties, however, of tilling lea for a drill crop, with ordinary implements, are often prohibitive, but, with the assistance of a good disc harrow, the cultivation of such land in the manner indicated presents no more difficulty than does the usual practice of cultivating the stubble for a root crop with ordinary implements. Where it is desired to till lea for potatoes or roots, the best method of carrying out the operation is first to disc harrow the grass land in both directions before ploughing, then plough, using a skim coulter to bury the "turves," and disc harrow the land several times, first

in the same direction as the ploughing and then across. If the first discing and ploughing are done in early winter and the land is allowed to lie 2 or 3 months before further cultivation is undertaken, cross ploughing is seldom necessary. All that is usually required to complete the cultivation are the subsequent disc harrowings indicated and the levelling of the land before drilling with an ordinary spring-tooth harrow. On very tough clay land cross ploughing may be necessary, especially in a winter when there is little frost. Under such circumstances the land should be disc harrowed, before the cross ploughing, otherwise this operation cuts the old furrow into big square pieces and makes the subsequent cultivation very difficult.

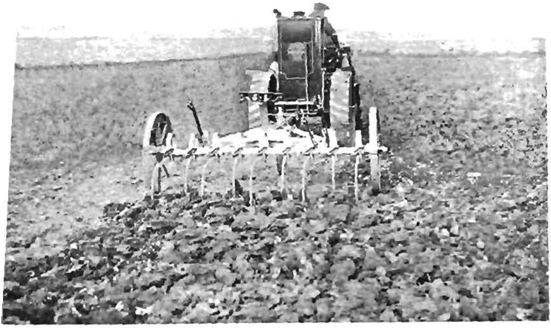
*Types of Disc Harrows.**—Both the horse and motor types of disc harrows are made with different kinds of discs.

There is the plain type of disc, and the serrated or cut-away type in which portions of the periphery of the disc blades are notched. In theory this arrangement is supposed to allow greater penetration into the soil than is possible with the plain disc. This claim is not borne out by practical experience, and, furthermore, the pulverising effect of the plain disc is greater than that of the cut-away type. Another type of disc harrow is called the spading disc, which has, in place of a plain or notched disc, six or more curved blades forming a kind of sprocket wheel. This type is specially suited for land containing a number of small stones, on which class of land the previous types are not of much use.

In some makes of horse disc harrows a shaft is provided to which the horses are attached in the same manner as they are hitched to a mowing machine or corn binder. Another type, in place of a shaft, has a fore carriage and swivel front. The latter has many advantages over the former. The shaft type racks the horses' necks, the draught cannot be raised or lowered, and the implement does not keep as steadily to its work as one provided with a fore carriage.

The number and sizes of the discs on the horse implement vary. The most useful type for a three-horse team is a disc harrow with 12 discs, each disc 20 in. in diameter. With this implement a certain amount of work can also be done with two horses, by removing the two outer discs, setting the disc at a smaller angle, and in certain cases lightening the draught by entirely removing the transport wheels. As

* The information given is based on Irish experience and may not be suitable for conditions in all parts of England.



6 B.H.P. Tractor hauling a Triple Cultivator on an Unploughed Rape Stubble.

10-B.H.P. Tractor hauling a Triple Cultivator with Mould Board Attachments for opening three drills.

a rule disc harrows described as two-horse implements have from 10 to 12 discs which vary in diameter from 14 in. to 18 in. In actual dynamometer trials which the writer has conducted, working at a uniform depth, with discs of various diameters, the larger the size of the disc the lighter, as might have been expected, is the draught. Hence the so-called two-horse machine requires a greater haulage force than does the larger type. Further, clogging is less liable to take place with the implement fitted with discs of big diameter than with one having smaller discs.

Motor Disc Harrows.—There is no fine line of demarcation between a horse and a motor disc. The heavy horse disc is equally well suited for use with the light motor. In this connection it will be useful to know that the three-horse disc is suitable for a 10-b.h.p. motor, whilst a motor of double this power can successfully haul a five or six-horse implement. The type which might, properly speaking, be described as a motor implement proper, is the double disc harrow. In this implement there are two double sets of discs, one set running immediately behind the other. The hind set of discs is usually arranged to cut in the opposite direction to the fore set. There are also single disc harrows made for motor work. These are built on the same lines as the horse disc, but have from 16 to 24 discs, and vary in width from 8 ft. to 12 ft. For a very sound reason the double disc harrow is the better implement. The wheel spread of an agricultural motor is usually about 6 ft., so that when such a motor is hauling a disc harrow of a greater width than 6 ft., *e.g.*, when overlap or double disc work is being performed, the motor is compelled to run on the freshly broken surface. This has two disadvantages. A loose surface results in back-slip taking place, and consequent loss of haulage power. Furthermore, a heavy motor running over the freshly turned-up soil compresses the land, and, to a certain extent, neutralizes the cultivation already done. Many makers claim that a motor does not press the land to a greater extent than is done when horses are used. They attempt to prove this statement by referring to the fact that the pressure per square inch is greater in the case of horse labour, where the pressure is concentrated, than when the pressure is distributed over the area covered by the motor wheels. This is mathematically true, but it should be borne in mind that a horse only presses the land on a comparatively small area, whereas the motor compresses the surface of the soil on the entire area passed over by the wheels.

That the popularity of the disc harrow is increasing may be gathered from the fact that eleven years ago there were not a dozen disc harrows in Ireland, and to-day, according to the Irish Department of Agriculture's latest census of implements, there are 2,000.

The Triple Cultivator.

Another implement which might be in more general use is the triple cultivator. This is really a combination of implements. In the first place the tines may be arranged so as to do ordinary cultivating work. They may also be arranged in sets of three, so as to grub or cultivate three drills at a time. In addition, moulding boards may be fitted so that three drills at a time may be opened or closed, and re-moulded up after cultivating operations. The economy of such an implement, where potatoes, roots, or other drill crops are grown on an extensive area, is very great. Not only is there a great saving as regards horse and manual labour, but every possible advantage can be taken of good weather conditions to push on with the work. This is an important consideration in the after-cultivation of root crops, which generally clashes with the hay and early corn harvests.

Many farmers imagine that the haulage power required to open, say, three drills is very great. This, however, is not the case. As a matter of fact, wherever two horses are capable of opening a single drill with the ordinary moulding plough three are easily able to open three drills with the triple cultivator, the reason for this being that in the case of the cultivator the weight of the machine is borne by the wheels.

In purchasing a triple cultivator care should be taken to obtain one with an expanding axle. This permits of the distance between the wheels being increased or decreased as desired. With an expanding axle drills may be made up to 36 in. wide—a very useful width where intercropping with potatoes is followed—or the drills may be as narrow as 18 in.—a width which may be used where beans are sown as a cleaning crop, or where such crops as kale, rape, etc., are grown in rows, on raised ridges. Where intercropping is followed, the wheels and mould board may be so arranged that the second or auxiliary drills can be opened for the planting of late potatoes or roots when the first crop is well advanced in growth. As will be understood, the opening of the auxiliary drills with such an implement helps to earth up the earlier planted potatoes.

A PRELIMINARY REPORT UPON THE ECONOMIC STATUS OF THE BRITISH SPECIES OF WOODPECKERS AND THEIR RELATION TO FORESTRY.

WALTER E. COLLINGE, M.Sc.,

Research Fellow of the University of St. Andrews.

THE economic status of the British species of Woodpeckers has long been a subject of dispute, and opinions regarding their usefulness or harmfulness, from the standpoint of the forester, are very varied.

It has often been stated that these birds damage sound trees by pecking holes in them or girdling them, and that they also wound saplings, feed upon the seeds of coniferous and other trees, and damage telegraph posts, but, in the absence of any systematic investigation into the nature of their food or the extent of damage they commit, it was difficult to say whether there were any grounds for such statements. In view, therefore, of the recent activities in re-afforesting large tracts of land in this country, the present investigation was commenced in order to obtain more exact knowledge of the habits of these birds.

For various reasons it has been found necessary to postpone the investigation, and as it will, therefore, be some little time before it is possible to complete it, it has been thought advisable to issue the present preliminary report.

Species Dealt With.—There are three species of woodpeckers in the British Isles, viz., the Great Spotted Woodpecker, *Dendrocopus major* (Linn.); the Lesser Spotted Woodpecker, *Dendrocopus minor* (Linn.); and the Green Woodpecker, *Gecinus viridis* (Linn.). The latter is by far the commonest, and the majority of the observations made have been on this species.

Examination of Stomach Contents.—Up to the present time 91 specimens have been examined, viz., 5, Great Spotted Woodpecker; 8, Lesser Spotted Woodpecker; and 78, Green Woodpecker. Fully 75 per cent. of the food has been found to consist of injurious insects, the principal species being :—

Osier Weevil (*Cryptorrhynchus lapathi*, Linn.).
Pine Weevil (*Hylobius abietis*, Fabr.).
Bark Beetles (Various species of *Tomicus*).
Pine Beetle (*Myelophilus piniperda*, Linn.).
Ash Bark Beetle (*Hylesinus fraxini*, Pz.).
Elm Bark Beetle (*Scolytus destructor*, Oliv.).
Black Pine Beetle (*Hylastes ater*, Payk.).

Small Poplar Longicorn (*Saperda populnea*, Linn.).
Common Longicorn (*Rhagium bifasciatum*, Fabr.).
Rhinoceros Beetle (*Sinodendron cylindricum*, Fabr.).
Shot-borer Beetle (*Xyleborus dispar*, F.).
Larvæ of the Pine-shoot Tortrix Moth (*Retinia buoliana*, Schiff.), the Birch Clearwing Moth (*Sesia culiciformis*) and the Wood Leopard Moth (*Zeuzera aesculi*, Linn.) have also occurred.

Of the remaining 25 per cent. of food, quite 20 per cent. consisted of ants, the further 5 per cent. being made up of 1 ladybird beetle, 2 spiders, and insect remains not identifiable.

Field Observations.—In the field observations the objects kept in view have been to obtain first-hand information on the following points: (1) the distribution of woodpeckers, (2) their nesting habits, and (3) their feeding habits. Considerable difficulty has been experienced in obtaining information on all these points, and the results have frequently been at variance with those obtained by local observers.

Briefly, the results of field observations to date may be summarised as follows:—

1. *Distribution.*—In many parts of the country the Green Woodpecker (*Gecinus viridis*, Linn.) has increased in numbers during the past 4 or 5 years. In a few localities it has decreased, and in a few others it has appeared for the first time.

2. *Nesting Habits.*—Beyond the fact that the writer has confirmed in upwards of 40 cases that where holes were made in trees for purposes of nesting, the trees were in all cases already injured or decaying, no new information has been obtained.

3. *Feeding Habits.*—Numerous observations in the open fully confirm the following two facts:—(1) that sound trees are seldom, if ever, attacked, and (2) that large numbers of insects are destroyed by woodpeckers. A careful investigation, extending over two years, shows that of upwards of a hundred trees attacked by these birds not a single one was previously sound. In this connection a practical forester writes to me: "Personally I always allow an ample margin in measuring a tree with a woodpecker hole in it, and generally find in timber-measuring that if I continually hear woodpecker calls, I am among a lot of unsound timber" (Surrey). Another states: "I have seen many trees blown and cut down, which have been bored into by woodpeckers, but I have found the trees more or less decayed, and there are plenty of such trees about here (Gloucester) now standing." Other letters and verbal communications bear out the above statements.

The quantity of insects eaten as food is in some cases surprising; thus in one case upwards of 1,300 beetles were found in the stomach, in another 1,100, and from 300 to 800 were common. Of the larvae of the larger timber-destroying beetles the remains of 57 examples of *Rhagium* represented the largest number found in one bird.

Observations on the Food of Nestlings.—Only two nestlings have been examined; these were from different districts, and of the Green Woodpecker. The stomach contents in both cases consisted entirely of beetle larvae.

Examination of Faeces.—Considerable difficulty has been experienced in obtaining the faeces of birds in the wild state, and the few examples examined are insufficient to enable any definite conclusions to be drawn. So far only insect remains have been discovered, and there is no evidence that would support the view, held by some foresters, that woodpeckers disseminate the seeds of weeds.

Relation to British Forestry.—From observations made in the laboratory and field, extending over two years, there is no doubt that woodpeckers are distinctly beneficial to forestry, and merit all the protection that can be afforded them. From an examination of the stomach contents alone, it would be impossible to come to any other conclusion. If, in addition, it is borne in mind that the birds destroy large numbers of timber-destroying insects during the nesting season, their value will be better realised.

As stated above, the writer has not met with a single case where sound timber has been attacked, and he has been unable to learn of a single authenticated case from the many foresters consulted or written to during this investigation.

Roman or Italian Geese.

THE Roman goose is found in southern Europe, chiefly in south Germany, Austria, Hungary, and Italy. It is a useful variety which is, however, not well known, and the breed appears to be uncommon in England.

Two varieties of Italian geese are found, one being pure white in plumage and the other parti-coloured. The birds are long in body, with a fine head and a short, thick beak, which is orange-red with a white tip. The wings, which are large, are carried well back, and the legs are of medium length. W. Godwin describes the parti-coloured variety as white with a blue-grey head, a grey spot between the shoulders, and a marbled-grey

patch on each thigh. Both sexes are marked alike and are attractive looking. The marks are reproduced almost without variation, so that the variety possesses a fixed type.

Italian geese are smaller in size than the breeds usually found in northern and western Europe. When fully grown they weigh from 12 lb. to 14 lb., while at the age of from 6 to 8 months they weigh about 8 lb. or 9 lb.

These geese are very precocious and rapid in growth. They are chiefly remarkable for their great prolificacy in egg-laying, the average production being, in many cases, as high as 100 eggs per head per annum. According to Tegetmeier, 60 and 70 eggs have been produced by one of these birds in the spring, while very frequently the birds lay also in the autumn, after moulting.

Tegetmeier states that when crossed with Embden geese the Italian breed produces large and superior table birds. A bird which won a first prize at Birmingham in 1892 was of the Italian–Embden cross and weighed 24 lb., while in the following year the same breeder showed two birds of the same cross weighing 21 lb. each, alive.

The chief advantages of Italian geese may be summed up as follows:—They are prolific egg-layers; they come early to maturity; the young birds are easy to rear; they are very fleshy and light in bone; while the meat is not in any way inferior to that of other breeds.

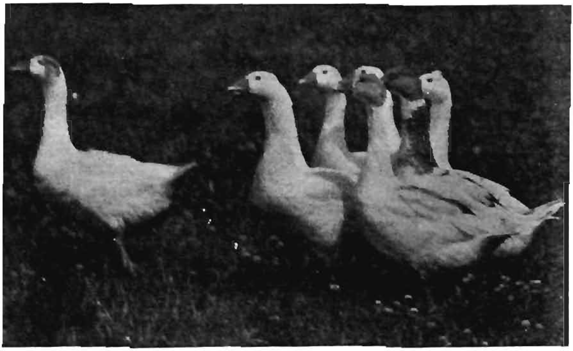
A complaint often made against the goose in general is that it is too large for ordinary households, and for this reason the introduction of Italian geese into this country would tend to re-establish the former popularity of the goose by providing birds of a size more suited to average modern requirements.

Notes on Feeding Stuffs in November: *From the Animal Nutrition Institute, Cambridge University.*

THE winter feeding season begins in earnest this month and it therefore seems desirable to introduce into these notes certain new features. The usual table of prices of the common feeding stuffs at London, Liverpool, Hull, and Bristol, will be found on p. 793, and the list of average costs per food unit arranged in order on p. 794. In addition to these two tables, which have appeared in former monthly notes, a third table (p. 797) has been prepared in which the various feeding stuffs are classified

Roman Gander.

Roman Goose.



Group of Roman Geese.

TABLE I.

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate prices per ton at the end of October.				Approximate prices per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya Bean Cake	1 : 1·1	122·3	9 0 0	9 10 0	9 0 0	9 0 0	1 5¾	1 6½	1 5¾	1 5¾
Decorticated Cotton Cake	1 : 1·3	126·3	9 17 6	11 10 0	—	10 5 0	1 6¾	1 9¾	—	1 7½
Indian Linseed Cake	1 : 1·9	123·1	11 5 0	11 5 0	—	—	1 10	1 10	—	—
English Linseed Cake	1 : 2·0	120·1	11 15 0	12 15 0	11 7 6	11 17 6	1 11½	2 1½	1 10¾	1 11¾
Bombay Cotton Cake	1 : 2·4	65·3	9 5 0	8 2 6	8 2 6	8 10 0	2 10	2 6	2 6	2 7¾
Egyptian Cotton Cake	1 : 2·0	71·9	9 10 0	8 12 6	8 12 6	8 17 6	2 7¾	2 4¾	2 4¾	2 3¾
Coconut Cake	1 : 3·8	102·6	8 7 6	8 10 0	—	9 0 0	1 7¾	1 8	—	1 9
Palm-nut Kernel Cake	1 : 4·0	83·5	8 0 0	7 0 0	7 7 6	7 10 0	1 11	1 8	1 9¼	1 9½
Ground-nut Cake	1 : 0·9	145·2	*9 3 9	8 0 0	—	9 0 0	1 3¼	1 1¼	—	1 3
English Beans	1 : 2·6	99·5	10 0 0	11 8 8	9 13 8	10 10 6	2 0	2 3½	1 11¼	2 1½
Chinese Beans	1 : 2·6	101·2	10 4 2	10 5 4	—	—	2 0¼	2 0¼	—	—
English Maple Peas	1 : 3·2	97·2	13 6 8	14 13 4	13 2 3	—	2 9	3 0¼	2 8¼	—
English Dun Peas	1 : 3·2	97·2	12 0 0	—	12 8 11	—	2 5¾	—	2 6¾	—
Calcutta White Peas	1 : 2·3	97·5	14 0 0	14 11 2	—	—	2 10½	2 11¾	—	—
American Maize	1 : 11	93·8	9 11 4	—	—	—	2 0½	—	—	—
Argentine Maize	1 : 11	94·2	7 18 8	8 2 6	7 14 0	7 16 4	1 8¼	1 8½	1 7¾	1 8
Maize Meal	1 : 13	86·5	8 12 6	8 17 6	8 12 6	8 10 0	2 0	2 0½	2 0	1 11¼
Maize Gluten Feed	1 : 3·3	121·6	8 2 6	—	—	8 10 0	1 4	—	—	1 4¾
Maize Germ Meal	1 : 8·4	99·2	8 10 0	8 15 0	8 10 0	8 15 0	1 8¼	1 9	1 8½	1 9
English Feeding Barley	1 : 7·8	83·0	11 4 0	—	11 15 2	12 0 10	2 8¼	—	2 10	2 10¾
English Oats	1 : 7·9	75·4	11 13 4	10 15 8	10 6 8	10 16 8	3 1	2 10¼	2 9	2 10¼
Argentine Oats	1 : 7·9	75·4	11 8 5	10 11 7	—	10 17 4	3 0¼	2 9½	—	2 10¼
Malt Culms	1 : 3·6	69·9	6 0 0	—	5 10 0	6 10 0	1 8¾	—	1 6¾	1 10¼
Brewers' Grains (dried)	1 : 3·4	84·5	‖7 5 0	—	6 15 0	7 0 0	1 8¾	—	1 7¼	1 8
Brewers' Grains (wet)	1 : 3·4	21·1	†0 18 6	—	1 5 0	—	0 10½	—	1 2½	—
Egyptian Rice Meal	1 : 10·3	78·7	8 0 0	—	—	—	2 0½	—	—	—
Burmese Rice Meal	1 : 10·3	78·7	7 0 0	7 10 0	6 10 0	7 10 0	1 9¼	1 11	1 8	1 11
Wheat Middlings	1 : 5·3	93·4	8 10 0	—	7 5 0	10 5 0	1 9¾	—	1 6¾	2 2¼
Wheat Sharps	1 : 5·3	86·3	8 8 9	9 7 6	9 5 0	9 5 0	1 11½	2 2	2 1¾	2 1¾
Wheat Pollards	1 : 5·3	81·9	—	7 7 6	—	—	—	1 9½	—	—
Wheat Bran	1 : 5·3	77·5	6 15 0	6 17 6	6 15 0	7 5 0	1 8¾	1 9¼	1 8¾	1 10½
Wheat Bran (broad)	1 : 4·7	79·9	7 15 0	7 7 6	7 15 0	7 15 0	1 11¼	1 10	1 11¼	1 11¼
Feeding Treacle	—	60·0	8 5 0	8 10 0	—	—	2 9	2 10	—	—
Linseed	1 : 5·4	153·5	15 6 11	17 5 0	16 8 6	15 9 7	2 0	2 3	2 1¾	2 0½
Linseed Oil	—	250·0	28 0 0	33 0 0	26 12 6	37 6 8	2 3	2 7¾	2 1¼	2 11¾

* 2nd grade, £8 3s. 9d ‖ Porter grains (London), £7 † Porter grains (London), 17s.

according to their composition. This table also includes the starch equivalents of the various feeding stuffs, and shows how much linseed cake is equivalent to 100 lb. of each feeding stuff. Linseed cake has been selected as the standard because it is more familiar to the majority of stock keepers as a feeding stuff than is starch. The exact meaning of these two columns will be explained below.

Comparison of Table II. with the similar table given last month shows that feeding stuffs generally have increased in price by from 1*d*. to 3*d*. per food unit. A few feeding stuffs,

TABLE II.

Average Prices per Food Unit.

	s.	*d.*		*s.*	*d.*
Brewers' grains (wet) ..	1	0½	Maize meal	2	0
Ground-nut cake ..	1	2½	Beans, Chinese	2	0¼
Maize gluten feed ..	1	4¼	Maize, American ..	2	0½
Soya-bean cake	1	6	Rice meal, Egyptian ..	2	0½
Decorticated cotton cake	1	8	Beans, English	2	1
Brewers' grains (dried) ..	1	8	Wheat sharps	2	1¼
Coco-nut cake	1	8¼	Linseed	2	1¼
Maize, Argentine	1	8¼	Cotton cake, Egyptian	2	5¾
Malt culms	1	8½	Linseed oil	2	6
Maize germ meal ..	1	8¾	Peas, English dun ..	2	6¼
Wheat bran	1	9¼	Cotton cake, Bombay ..	2	7¼
Palm-nut kernel cake ..	1	9½	Feeding treacle	2	9½
Wheat pollards	1	9½	Barley, English feeding	2	9¾
Rice meal, Burmese ..	1	9¾	Peas, English maple ..	2	10
Linseed cake, Indian ..	1	10	Oats, English	2	10¾
Wheat middlings ..	1	10¼	,, Argentine ..	2	10¾
,, bran (broad) ..	1	11	Peas, Calcutta white ..	2	11
Linseed cake, English ..	2	0			

however, have remained at the same price as last month, or even decreased slightly. Amongst these are ground-nut cake, maize gluten feed, malt culms, decorticated cotton cake and Indian linseed cake. The largest increases in price are shown by oats and undecorticated cotton cake, the price of the latter being now almost prohibitive.

Last month some space was devoted to the explanation of the fundamental principles of nutrition. It is desirable this month to give a little further explanation in order to make clear the meaning of Table III. In this table the feeding stuffs are classified according to their richness in proteins, or flesh-formers, as expressed by their nutritive ratios. The classification also shows how much digestible fat is contained in each feeding stuff. For the first time in these notes has been introduced (column 5 of Table III.) the term "starch

equivalent." The figures in this column give the number of pounds of starch, which, when added to a maintenance ration of coarse fodder, such as roots and straw, give the same increase in live-weight as 100 lb. of the feeding stuff so added. These figures have been ascertained by feeding experiments, of which the following is a very brief outline:—

A store ox is kept on such a ration of roots and hay or straw as will suffice to make him "hold his own," as graziers say, *i.e.*, will just prevent his losing weight. To this ration a known weight of starch is added, when it is found that the ox gains in live-weight at the rate of about 1 lb. for each 4 lb. of starch. The animal is then once more put on the maintenance diet of roots and straw. As soon as his weight is once more steady, a known weight of the feeding stuff under experiment is added to his ration, and the increase in live-weight produced by this addition is found. In the case of experiments with linseed cake it was found that to produce 1 lb. of live-weight increase about 5 lb. of linseed cake were required. Thus, for production of live-weight increase, 5 lb. of linseed cake are equivalent to 4 lb. of starch, or 100 lb. of linseed cake are equivalent to about 80 lb. of starch, and the starch equivalent of linseed cake is therefore about 80.

When described in this way such experiments seem delightfully simple, but, as a matter of fact, so many precautions are necessary to ensure their accuracy that they can only be carried out with extreme difficulty. Numbers of them have been carried out with the greatest possible care, with the results given in column 5 of Table III. *These figures are not theoretical figures arrived at by calculation, but, as explained above, are the result of direct experiments* in which the increases in live-weight produced by the various feeding stuffs were measured with every possible precaution to ensure accuracy. They are the most reliable measure of the productive capacity of the different feeding stuffs, at any rate for producing increase in live-weight, and probably, too, for producing both work and milk. It may be asked why it is not recommended that feeding stuffs should be bought on their starch equivalents. The reason is that in buying feeding stuffs for the farm their varying manurial values must not be lost sight of. The food-unit method allows for manurial value. In the starch equivalent figures manurial value is ignored. *Therefore, farmers should buy on food units, but feed according to starch equivalents.*

Farmers may have some difficulty in grasping this idea of starch equivalents because they are not familiar with starch as a feeding stuff. Although starch in the pure form is not used in ordinary practice, it may be noted that the cereal

grains, wheat, barley, oats, maize and rice, contain about half their weight of starch, beans and peas nearly as much, and potatoes about 20 per cent. Starch is, therefore, one of the most abundant constituents of foods. To make the point clearer, however, we have calculated from the starch equivalents column 6, which shows the weights of linseed cake which may be expected to give the same increase in live-weight as 100 lb. of each feeding stuff. Here the following proviso must be made. When it is stated that 100 lb. of beans are likely to produce as much increase in live-weight as 88 lb. of linseed cake, no more is implied than is said. It is not implied, for instance, that 100 lb. of beans are equal in all respects to 88 lb. of linseed cake. Every one familiar with the general properties of these two feeding stuffs knows that they are not equal in all respects. Linseed cake, for instance, contains enough linseed oil to make it have a relaxing effect on the bowels. Beans are, on the contrary, inclined to cause constipation. In order that a feeding stuff may realise, in practice, the full value indicated by its L. C. (linseed cake) equivalent, we must be so familiar with its general properties as to enable us to use it to the best advantage. For instance, we should not get the full value out of such a reliable food as linseed cake if we used it for young stock on soppy aftermath. Although the starch equivalent of cotton cake is only 40, and its L. C. equivalent only 53, it would give a better return than linseed cake under these conditions, because its astringency would counterbalance the sloppiness of the aftermath.

Summing up the above remarks it may be concluded that, provided we are sufficiently familiar with the general properties of the feeding stuffs when used in actual practice to enable us to use them to the best advantage, the starch or linseed cake equivalents give us a good measure of their relative feeding value.

To use the information contained in Table III. the procedure is as follows :—We know that a mixture of equal quantities of linseed cake and cotton cake is a safe concentrated food for supplementing a diet of roots and straw for fattening bullocks, and that the daily ration of this mixture for animals weighing about 900 lb. live-weight is an average during the period of fattening of about 7 lb. per head. Now linseed cake and cotton cake both have nutritive ratios of about 1 : 2, and the mixture of them contains about 7 per cent. of oil. It is desired to replace this mixture by an equivalent

amount of cheaper foods. The cheapest food in the linseed cake class is ground-nut cake. Ground-nut cake, however, contains too much protein to be used by itself, so it must be mixed with something having a wider nutritive ratio. Since it is not very rich in oil, it will be best to mix it with something not very poor in oil; suitable substances are maize, dried grains, rice meal, or some kind of wheat offal, and of

TABLE III.

(1) Name of Feeding Stuff.	(2) Nutritive Ratio.	(3) Per cent. digestible. Protein.	(4) Per cent. digestible. Fat.	(5) Starch equiv. per 100 lb.	(6) Linseed Cake equiv. per 100 lb.
Foods Rich in both Protein and Oil or Fat.					
Ground-nut cake	1 : 0·9	45·2	6·3	77·5	102
Soya-bean cake	1 : 1·1	34·0	6·5	66·7	88
Decort. Cotton cake	1 : 1·3	34·0	8·5	71·0	93
Linseed cake, Indian	1 : 1·9	27·8	9·3	77·1	101
Linseed cake, English	1 : 2·0	26·7	9·3	76·0	100
Cotton cake, Egyptian	1 : 2·0	15·5	5·3	40·0	53
Cotton cake, Bombay	1 : 2·4	13·1	4·4	37·6	49
Maize gluten feed	1 : 3·3	20·4	8·8	87·4	115
Brewers' grains, dried	1 : 3·4	14·1	6·6	50·3	66
Coco-nut cake	1 : 3·8	16·3	8·2	76·5	101
Palm-nut kernel cake	1 : 4·0	12·5	7·7	63·0	83
Linseed	1 : 5·4	18·1	34·7	119·2	157
Fairly Rich in Protein, Rich in Oil.					
Maize germ meal	1 : 8·4	9·0	6·2	81·0	107
Rice meal	1 : 10·3	6·8	10·2	68·4	90
Rich in Protein, Poor in Oil.					
Peas, Calcutta, white	1 : 2·3	23·3	1·1	66·9	88
Beans, English	1 : 2·6	19·3	1·2	67·0	88
Beans, Chinese	1 : 2·6	19·6	1·7	67·0	88
Peas, English maple	1 : 3·2	17·0	1·0	70·0	92
Brewers' grains, wet	1 : 3·4	3·5	1·5	12·7	17
Malt culms	1 : 3·6	11·4	1·1	38·7	51
Cereals, Rich in Starch, not Rich in Protein or Oil.					
Barley, feeding	1 : 7·8	8·0	2·1	67·9	89
Oats, English	1 : 7·9	7·2	4·0	59·7	79
Oats, Argentine	1 : 7·9	7·2	4·0	59·7	79
Maize, American	1 : 11·0	6·7	4·5	81·0	107
Maize, Argentine	1 : 11·0	6·8	4·5	83·5	110
Maize meal	1 : 13·0	5·5	3·5	77·8	102
Wheat middlings	1 : 5·3	12·0	3·0	59·1	78
Wheat sharps	1 : 5·0	12·0	4·0	58·4	77
Wheat pollards	1 : 5·0	11·6	3·5	54·1	71
Wheat bran	1 : 5·0	11·3	3·0	49·7	65
Wheat bran broad	1 : 4·7	11·3	3·0	48·1	63

these maize and dried grains are the cheapest. A mixture of ground-nut cake and dried grains would have a nutritive ratio of about 1 : 2, and would contain about 6½ per cent. of oil. It would thus have almost exactly the same composition as the mixture of linseed cake and cotton cake. The column of L. C. equivalents shows that ground-nut cake is equal for fat production to rather more than its own weight of

linseed cake. Dried grains are equal to only 66 per cent., or two-thirds of their weight of linseed cake, and cotton cake to only half its own weight of linseed cake. To get the equivalent of 7 lb. of mixed linseed and cotton cakes we must use about 3¼ lb. of ground-nut cake mixed with about 2¼ lb. of dried grains. Such a mixture should have about the same value for producing fattening increase as 7 lb. of mixed linseed and cotton cakes, provided that ground-nut cake turns out to be a healthy food when used under these conditions.

If it is decided to replace the standard mixture by ground-nut cake and maize, we must use more cake than maize, or we shall not get enough protein. About 4 lb. of ground-nut cake mixed with 2 lb. of maize will have rather a wider nutritive ratio than the standard mixture, but will still supply enough protein for full-grown bullocks; it will contain about 5 per cent. of oil; and since ground-nut cake and maize are each equal to rather more than their own weight of linseed cake for the production of fattening increase, about 5 lb. of the mixture will be equivalent to 7 lb. of mixed linseed and cotton cakes.

These two instances illustrate the use of the table. The columns giving nutritive ratio and oil show us in what *proportions* to mix foods so that the mixture may have the same composition as the food we wish to replace, and the L. C. equivalents show us *how much* of the mixture will be equivalent to the weight of food we are replacing. It is wasteful to replace cotton cake by an equal weight of maize, for the L. C. equivalents of these foods show that 1 lb. of maize is equivalent for fat production to 2 lb. of cotton cake. *Unless we allow for such facts in rearranging diets we shall not get the full economic advantage of using cheaper mixtures.*

Suggested Rations for November.—Rations may now be suggested in the light of what has been said above.

For Horses at Farm Work.—Experience has shown that horses of average size work well in the winter, and keep in good condition on ordinary allowances of hay or straw, or a mixture of the two, in addition to a weekly allowance of 2 bush. per head of oats, or 12 lb. per head on working days, and 6 lb. on Sunday. At present prices oats may be replaced with very great economy by either of the following mixtures :—

I.	Crushed maize ..	2 parts.	II.	Crushed maize ..	2 parts.
	Dried brewers' grains	2 ,,		,, beans ..	1 part.
	Rice meal (rich in fat)	1 part.		Bran	2 parts.

These mixtures have about the same composition as oats, and give good results with working horses in practice. Reference to their L. C. equivalents, however, shows that they are about one-tenth higher in feeding value than oats, so that about 11 lb. per head per day should be used to replace 12 lb. of oats.

For Breeding Mares and Weaned Foals.—It is doubtful economy to dispense entirely with oats for such important animals. For rations see last month's notes.

For Milch Cows.—The following ration is recognised as suitable for a cow of about 1,100 lb. live-weight giving about 2 gal. of milk a day.

Roots ..	56 lb.	+	Bran	3 lb.	= 5 lb. concentrated food.
Hay ..	8 ,,		Linseed cake	1 ,,	
Straw ..	12 ,,		Undecorticated cotton cake	1 ,,	

It is also recognised that it is necessary to give about 2 lb. extra of the concentrated food mixture for each extra gallon of milk. Though quite suitable, this mixture is expensive at present prices. Bran is rising in price every month ; linseed cake is dear ; and the present price of undecorticated cotton cake is almost prohibitive.

The following mixtures have about the same composition as the mixture of bran, linseed cake, and undecorticated cotton cake, recommended above :—

I. Maize gluten feed ..	1 part.	II. Decorticated cotton cake	3 parts.
Dried brewers' grains	1 ,,	Crushed maize ..	2 ,,
Coco-nut cake ..	1 ,,		

III. Malt culms	2 parts.
Coco-nut cake ..	1 part.
Rice meal	1 ,,

I. and II. are about one-third higher in feeding value than the standard mixture, and III. is about equivalent to the standard mixture. The rations, therefore, are as follows :— Of mixtures I. and II., 4 lb. per head per day, with 1½ lb. extra for each extra gallon of milk. Of Mixture III., 5 lb. per head per day, with 2 lb. extra for each extra gallon of milk.

For Fattening Bullocks.—The following is a typical ration for a bullock of 900 lb. live-weight when starting to fatten in the winter :—

Roots	84 lb.
Hay and straw	8–10 ,,

Linseed cake and undecorticated cotton cake, 4 lb., rising to 10 lb., averaging 7 lb.

On such a ration bullocks will fatten in about 16 weeks ; its only fault is the very high price of the cake.

The root crop is good in many districts this year, and where roots are plentiful the most economical plan will be to approach as near as may be to the old-fashioned ration of plenty of roots, straw, and time, which used to be considered capable of fattening any bullock. It will, however, be best to use some cake in addition, for, as was shown last month, roots and straw are not rich enough in protein to form the whole of a fattening diet. They provide plenty of carbohydrates, and plenty of bulk to fill the animals, but for the best results more protein and oil are desirable. The cheapest source of protein and oil at present prices is ground-nut cake, which may be used at the rate of 3 lb. per head per day, rising to 5 lb. With all the roots and straw the animals will eat, this allowance of ground-nut cake will make a well-balanced diet. It may be advisable to top up with 2 lb. of linseed cake in addition for the last fortnight.

If the root crop is short, and the animals can only be allowed something like 56 lb. per head per day, or if, as is sometimes the case, the animals will not eat more than 56 lb., more concentrated food must be provided. Ground-nut cake alone is under these circumstances too rich in protein to be used in large quantities. The following are worthy of trial :—

I. Palm-nut kernel cake.
II. Ground-nut cake and maize meal, half and half.
III. Decorticated cotton cake and crushed maize, half and half.

These are about right as regards nutritive ratio for use with a small ration of roots, such as is mentioned above. Their feeding values, however, differ considerably. Palm-nut kernel cake should be used at the rate of 4 lb. per head per day, rising to 8 lb. The ration for II. or III. will be 3 lb., rising to 7 lb. In the case of all these foods it is advisable to begin for the first few days with small quantities until the animals get used to them, when they may be gradually increased up to the suggested rations. Where possible it will probably pay to finish during the last fortnight with 2 lb. per head per day of linseed cake in addition.

For Stores intended for Grass Beef next Summer.—Such young stock on grass in the autumn require careful treatment. Filling themselves with old, more or less dead, grass they are liable to become distended, or "mawbound." This can generally be removed by a dose of linseed oil as soon as it is noticed. At the same time the wet green grass may cause scouring. For these reasons it is somewhat risky to dispense

entirely with linseed and cotton cake. Some such mixture as the following may be suggested :—

Coconut cake	2 parts.	Ration 3 to 4 lb. per head per day.
Linseed cake	1 part.	
Undecorticated cotton cake ..	1 ,,	

Further economy might be effected by using palm-nut kernel cake at the rate of 3 lb. to 4 lb. per head per day, but the writers have some diffidence in recommending this ration, as they have no personal experience of its use for this purpose.

For Stores in the Yards about 18 *Months Old or over.*—It is a common practice to allow stores of this description a bare maintenance diet, that is to say, just enough food to keep them from losing weight. This practice is never truly economical, for a given expenditure in food produces far more live-weight increase when eaten by young stock than when fed to adult animals. Under present conditions, when food is dear and beef makes a very high price, it is most certainly bad practice not to push on stores during the winter.

Where the root crop is short, and only a small ration of roots can be spared for the young stock, a sound ration of concentrated food to use, together with straw and a small root ration, is 2 lb. to 3 lb. per head per day of a mixture of 3 parts undecorticated cotton cake, and 1 part linseed cake. At present prices this ration would be very expensive. It may be economically replaced by some such mixture as the following :—Ground-nut cake and rice meal, half-and-half ; or decorticated cotton cake and rice meal, half-and-half. Reference to Table III. will show that these mixtures are considerably higher in feeding value than cotton cake and linseed cake ; they should, therefore, be used in smaller quantities. A suitable ration is 1½ lb. to 2½ lb. per per head per day according to age and condition.

Where the root crop is plentiful, young stock should get a full ration of roots and straw, supplemented with 1½ lb. to 2 lb. per head per day of ground-nut cake.

In districts where hay is plentiful, and can be spared for the young stock, with little or no roots, a less nitrogenous concentrated food may be used. Young stock will keep healthy, and make good progress on a hay diet supplemented with 2 lb. to 3 lb. per head per day of any of the following feeding stuffs :—Palm-nut kernel cake, rice meal, coconut cake, or dried grains.

For Calves or Young Stores 6 *to* 12 *Months Old.*—The remarks about the economy of pushing on young stock apply with

still more force to calves. To keep such young stock thriving it is advisable to spare them some hay for the bulky portion of their diet. The basis of their concentrated ration should be 5 parts of maize ground together with 1 part of linseed. In these proportions maize and linseed grind well together, and make a wholesome mellow food, which is an economical substitute for linseed cake at present prices.

Where hay is the basis of the diet the following concentrated ration will be found suitable and economical :—

Calves 6 months old: ¾ lb. per head per day of the maize-linseed mixture, together with ¾ lb. of bran, dried grains, or malt culms ; this ration to be gradually increased to double by the end of the winter. For older calves the ration should be increased according to age up to 3 lb. or 4 lb. per head per day.

Where no hay can be spared, and the basis of the diet is straw and a small ration of roots, the ration of concentrated food should be 2 lb. per head per day of the maize-linseed mixture for 6-month-old calves, rising to double by the end of the winter.

If it is possible to give a full ration of roots a better concentrated ration will be 1 lb. per head per day of the maize-linseed mixture, and 1 lb. of decorticated cotton cake or ground-nut cake. As before, this ration should be doubled by the end of the winter.

For Young Calves.—It is not possible here to give full directions for calf rearing, which is dealt with in an article at p. 768, and in Leaflets issued by the Board.

For Sheep Fattening on Roots.—Where plenty of roots are available of such quality that the sheep will eat a full ration, together with the usual allowance of hay or straw chaff, the following mixtures of concentrated foods are suitable and economical at present prices :—

I. Decorticated cotton cake	1 part.	II. Decorticated cotton cake	1 part.
Crushed maize	2 parts.	Dried grains	3 parts.
III. *Ground nut cake*	*1 part.*		
Crushed maize	3 parts.		

Mixtures I. and III. should begin at ½ lb., rising gradually to 1 lb. per head per day. Mixture II. has a lower feeding value, so that a higher ration is necessary ; the equivalent ration will be 10 oz., rising to 1¼ lb. per head per day.

Where the roots are not plentiful, or where they are dry, or tough, so that the sheep will not eat a full ration, it is

advisable, even at present prices, to include a little linseed cake in the concentrated mixture. The following mixtures and rations are suggested :—

I. Linseed cake..	.. 1 part.	II. Linseed cake	.. 1 part.
Decorticated cotton cake	.. 1 ,,	Decorticated cotton cake	.. 1 ,,
Crushed maize	.. 6 parts.	Dried grains	.. 7 parts.

III. Linseed cake	.. 1 part.
Ground-nut cake	.. 1 ,,
Crushed maize	.. 6 parts.

Suitable rations of I. and III. are ¾ lb., rising to 1¼ lb. per head per day. Mixture II. should be used in rather larger quantities—1 lb., rising to 1½ lb. per head per day.

These rations supply considerably less protein than many sheep feeders are accustomed to use, but our experience shows that sheep will fatten well on such rations, and that fewer unexplained deaths will occur than are usual on rations higher in protein.

For Ewes Heavy in Lamb, on Roots or Grass.—A safe and economical ration of concentrated food is 4 oz. to 6 oz. per head per day of bran or dried grains, together with the usual straw and hay " chop."

For Fattening Pigs.—The following mixtures are efficient substitutes for barley meal, which at present prices is out of the question for profitable pig feeding :—

I. Sharps and maize meal, half and half.
II. Maize germ meal and rice meal, half and half.

Rice meal for pig feeding need not be rich in oil, but care should be taken that it is not simply ground rice husks, which have little value for fattening. It is wise to buy rice meal on the basis of its analysis.

Home Production of Food.

THE Final Report of the Departmental Committee on the Home Production of Food has been published.* It will be remembered that in their Interim Report† (see *Journal*, September, 1915, page 585) the Committee recommended that a minimum price for wheat should be guaranteed by the State for a period of 4 years. The Government having decided not to adopt this recommendation, the Committee have considered in the Majority Report, which is signed by seven out of the nine members, by what other means the production of food in England and Wales might be increased during the war.

* Final Report [Cd. 8095], price 1½*d*.
† Interim Report [Cd. 8048], price 1*d*.

The Committee are convinced that there is great need to increase the productivity of the soil of this country, which, as they believe, falls far short of what it might be, by stimulating more intensive cultivation and by bringing under the plough a large area of land at present wastefully devoted to inferior pasture. Any increased production of food must rest upon a greater output from the soil, and from all the evidence laid before them, the Committee concluded that, speaking generally, the land of England is being kept at a comparatively low level of cultivation, and that it might be made to produce a greater amount of food without the withdrawal of labour from more profitable industries. In particular, the conversion of arable land into grass, which has taken place to the extent of nearly 4,000,000 acres during the last 40 years and is still going on, must necessarily be attended by a diminution in the amount of food produced. Evidence was received that a great deal of this land would produce twice as much meat and milk when under the plough as when in permanent grass, and that more, and not less, stock could be maintained on it if it were restored to arable cultivation, while it would also be producing corn for human consumption.

It is pointed out that the conversion of a considerable area of grass land into arable, bringing with it, as the Committee believe it must, a great increase in food supply, will be in the permanent interest of the nation. The intensification of British agriculture will be even more necessary after the war than now, for then the nation's indebtedness will have reduced its purchasing power abroad, and the need will be felt for the extra employment of labour that arable land provides. Moreover, at all times, a State purchasing the greater part of its food from foreign sources is *ipso facto* more open to attack and in a more unstable economic position when war comes. The Committee, therefore, hope that the importance of bringing poorer pastures under arable cultivation will be recognised by the Government and the agricultural community. In their opinion, it is only on these lines that a substantial increase in the home production of food can be achieved.

With a view to increase the supplies of fertilisers the Committee recommend that the Government should arrange with those who control the home-production of sulphate of ammonia for a sufficient supply to be available for farmers at as near pre-war prices as possible, using, if necessary, their

powers to restrict exports for the purpose. It is also suggested that shipping arrangements should be made for the importation at reduced rates of Florida and Tennessee phosphate rock, and of Chilian nitrate of soda, and that steps be taken to assist superphosphate makers to speed up their sulphuric acid producing plants.

The Committee recommend that immediate steps be taken to stimulate the breeding of pigs, and they suggest the formation of local societies through which loans of sows could be made to cottagers and small farmers.

In order to maintain, still more to increase, the agricultural output in England and Wales, it will be necessary to relieve the existing shortage of agricultural labour. The Committee recommend that steps should be taken (i) to retain skilled workers on the farms; (ii) to improve the organisation of women's labour; and (iii) to release soldiers in this country for farm work at time of pressure. They also recommend that the Government should assist the makers of agricultural machines of proved efficiency, particularly of motor tractors and ploughs, to increase their present output. It is further suggested that, in order to bring waste land in the neighbourhood of towns and villages under cultivation, local authorities should be enabled to take over such land at an agricultural rent. Landowners are urged to review the use made of their moorlands, with the object of seeing that they are grazed with as many sheep as they can carry, and to see that parks are used to their maximum capacity for grazing stock.

Six members of the Committee, namely, Lord Milner (the Chairman), Mr. E. G. Strutt, Mr. C. W. Fielding, Mr. A. D. Hall, Mr. Rowland E. Prothero, M.P., and Mr. J. A. Seddon add a note expressing the opinion that "it is necessary and practicable to produce within this country a very large proportion of the foodstuffs and other agricultural products natural to its soil, but now purchased abroad at a cost of nearly £300,000,000 per annum, two-thirds of which are derived from countries outside the British Empire." They believe that this can be done to the physical, social, and economic advantage of the country.

Mr. F. D. Acland, Mr. Fielding, and Mr. Hall urge, in a separate memorandum, the organisation of educational methods so as to effect an improvement in production. Their colleagues, while not differing from these proposals, thought them of too detailed a character for inclusion in the Report. Mr. Acland also recommends steps to be taken with the object of reducing the number of rabbits, game, and foxes.

A Minority Report is signed by Lord Inchcape and Sir Harry Verney explaining the reasons which prevent them from adhering to the main Report. They state that the recommendations contained in the latter are intended to apply to conditions after the war, with which the Committee were not invited to deal. They expressly abstain from adhering to the opinion that the nation's purchasing power will hereafter be reduced, or that it is necessary and possible to raise in this country a very large proportion of nearly £300,000,000 worth of food now purchased abroad.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

Manganese and Radio-Active Manure (*Die Landw. Versuchs-Stat., Band lxxxvii, Heft* 1 ; *B. Schulze, Breslau*). Pot experiments on sugar beet showed that manganese nitrate, phosphate, sulphate, and a mixture of the hydroxide and carbonate all increased the yield of roots. Averaging the yields from the different sized dressings given, the best results were obtained from the phosphate and a mixture of the sulphate with aluminium sulphate, although the highest yield of the whole experiment was given by the smallest quantity of the nitrate tried (*i.e.*, such that ·006 per cent. of the contents of the pots consisted of manganese).

A radio-active manure supplied by the Banque du Radium produced increased yields of oats and mustard.

It was concluded that the action of the manganese and radio-active substance was that of stimulants.

Radium as Manure (*Science* [*U.S.A.*] 14th May, 1915).—The University of Illinois Agricultural Experiment Station carried out experiments in 1913 and 1914 with radium salts furnished by the Standard Chemical Company of Pittsburgh, these salts being used in amounts so as to supply ·01 milligram, ·1 milligram, and 1 milligram of radium per acre ; such small amounts were applied in order to avoid any appreciable effect from the salts other than that due to radio-activity.

From the two years' work, six trustworthy results were obtained with a maize crop, three " for " and three " against " radium ; and eighteen trustworthy results with soya beans, nine " for " and nine " against " radium.

The conclusion is reached that " radium, with all its wonderful energy, is found upon careful analysis of the known facts, to afford no foundation for reasonable expectations of increased crop yields, when financial possibilities are considered . . . the heat evolved by 1,000 dollars worth of radium on an acre of land in 100 days [the period of good crop growing weather] would be less than the heat received from the sun on one square foot in 30 seconds."

* A summary of reports on agricultural experiments and investigations recently received is given regularly. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.

Sterilisation of Soil (*Ohio Agric. Expt. Sta. Circ. No.* 151).—It has become clear in Ohio that some method of soil sterilisation must be used to check the accumulation of disease organisms in greenhouses used for continuous cropping and in plant beds or cold frames used for growing seedling plants for outdoor use.

Originally the perforated pipe method of steaming was most largely used but has been replaced in the Cleveland district by the inverted pan method. In the pipe method perforated pipes are buried in the soil, the surface being covered with canvas or other covering and steam passed into the pipes at high pressure for such a period as is required to heat the soil to the necessary temperature. In the inverted pan method the apparatus consists of a galvanised iron pan with sharp edges which are forced into the soil on all sides so as to prevent the escape of the steam when the latter is admitted under pressure. With either method the steaming is carried on long enough to heat and sterilise the soil, at least one hour being required.

Formalin has proved effective but more expensive than the above methods.

FIELD CROPS.

Varieties of Wheat (*Univ. of Leeds and Yorks. Co. for Agric. Educ., Rept. No.* 97; *J. Potts, B.Sc., N.D.D.*).—Wheat followed oats after swedes (half-consumed on land), on a medium loam. The seed was pickled with bluestone and drilled at the rate of 3 bush. per acre on 24th October, 1914. A wet autumn and winter, a cold, dry spring, an unsettled summer and a fine September were experienced. During December and January the wheat was eaten close to the ground by rabbits; in early May it was noticed that hares showed a preference for Iron and Extra Squarehead II., two of the Swedish varieties. On 15th April the plots were dressed with 1 cwt. nitrate of soda and 1 cwt. salt. The yields per acre in 1915, the average yields from 1912–15, and the total value (grain and straw) per acre in 1915 on the basis of the estimated monetary returns are as follows:—

—	Yield, 1915		Value, 1915.	Average Yield, 1912–15.	
	Grain.	Straw.		Grain.	Straw.
	Bush.	Cwt.	£ s. d.	Bush.	Cwt.
Garton's Benefactor ...	36¾	24	12 4 2	—	—
Garton's Victor	36½	23½	11 13 0	45¾	31¼
Iron (Svalöf)	36¼	27½	11 6 8	—	—
Grenadier (Svalöf) ...	34	26	10 16 10	—	—
Sun (Svalöf)	33½	23¾	10 11 9	41¼	30¼
Little Joss	33¼	27	10 14 0	43½	33¾
Carter's White Standup...	33¼	23½	10 18 7	41	30¼
Webb's Standard Red ...	32	25¼	10 5 1	41½	32
Squarehead's Master ...	31½	24¾	10 5 5	41¼	33½
Browick Grey Chaff ...	30	26	9 18 0	40¾	33
Extra Squarehead II. (Svalöf)	27¾	22½	8 16 7	40	33¼

Benefactor is a white wheat recently introduced by Messrs. Garton's. It has been grown only once at Garforth, when both yield and quality of grain were excellent. The ear is very broad and compact, while the glumes are covered with hairs; it seems not unlikely that the ears

would hold water in a wet harvest, and that the grain would quickly sprout in the stook in wet weather.

Grenadier, Sun, Iron and Squarehead II., introduced from Svalöf, are red-grained white-chaffed wheats with very strong straw ; Grenadier is recommended for soils on which wheat is apt to lodge. At Garforth, Sun has always given grain of excellent quality, but the yield of straw has not been high. Iron ripens a few days later than the varieties usually grown in England. Squarehead II. is recommended for the stronger and better soils.

Varieties of Wheat (*E. Suffolk Educ. Com.*).—Seven varieties were grown in 1915 at five centres on soils of a fairly heavy type. The average yields of wheat in bush. per acre were as follows :—Victor, 41¼ ; Brooker's Double Standup, 41 ; Little Joss, 40¾ ; Wilhelmina, 40½ ; Swedish Squarehead II., 38¾ ; Squarehead's Master, 38½ ; Swedish Grenadier III., 38. Squarehead's Master and Little Joss were of very good quality, Wilhelmina, Victor, Brooker's Double Standup and Swedish Extra Squarehead II. were of medium quality, while Swedish Grenadier III. was poor.

The Swedish wheats are especially suited for very rich land, or to conditions where there is a probability that other kinds will be laid. Swedish Squarehead II. is especially strong in the straw.

Varieties of Winter Oats (*Univ. of Leeds and Yorks. Co. for Agric. Educ., Rept. No.* 97 ; *J. Potts, B.Sc., N.D.D.*).—The oats followed " seeds " grazed, after barley, after oats, the soil being a medium loam ; 4 bush. of seed per acre were drilled in on 1st October, 1914 ; ¾ cwt. nitrate of soda and 1 cwt. salt per acre were applied on 17th April. The yields per acre were as follows : Black Winter Oat (seed from Woodhead and Sons, Leeds), 46½ bush. grain, 22½ cwt. straw ; Garton's Prolific Dun Oat, 44½ bush. grain, 25 cwt. straw ; Webb's Black Winter Oat, 44 bush. grain, 23¼ cwt. straw ; Garton's Bountiful, 31½ bush. grain, 19¾ cwt. straw.

Webb's Black Winter Oat was the best sample, being the best in colour and the most evenly grown ; the Black Winter Oat (Woodhead's seed) was not of such good colour and contained more imperfectly developed grains. Dun Oat is not a good selling oat owing to its grey or dun colour ; it was very evenly grown, but not so plump in the grain as the black oats ; however, it appeared to be thin skinned, and there were hardly any empty husks. Bountiful contained a large proportion of badly-developed grains.

POULTRY.

Final Results of the Ten Months' Laying Competition of the Harper Adams Agricultural College and the Utility Poultry Club.—This competition finished on 30th August last, having continued for 10 calendar months, or a total of 304 days. The average results per bird compare very favourably with those obtained in the two preceding competitions lasting for the full 12 months, as will be seen from the following records :—

—	Average per bird.	
	Eggs.	Value. s. d.
1912–13 (12 months)	152	14 5
1913–14 (12 „)	187	19 0
1914–15 (10 „)	169	17 4

The results in the different breed sections were as follows :—

—	Average per bird.	
	Eggs.	Value. s. d.
Section I.—(Leghorns)	176	17 7
„ II.—(Wyandottes)	167	17 5
„ III.—(Buff Orpingtons, Barred Rocks and Rhode Island Reds) ..	165	17 2
„ IV.—(Sussex and Faverolles)	155	16 0

The largest number of eggs laid per pen, viz., 1,302 (valued at £6 18*s*. 4*d*.) came from a pen of Leghorns, this pen including the best layer (253 eggs) of the whole competition. No less than 24 birds in the Leghorn section laid over 200 eggs in the 304 days.

The Wyandottes section included the winning pen, laying 1,272 eggs valued at £7.

The best pen in Section III. was one of Barred Rocks, which laid a total of 1,157 eggs valued at £6 1*s*. 7*d*.

In Section IV. (containing 6 pens) 2 pens succeeded in laying over 1,000 eggs.

OFFICIAL NOTICES AND CIRCULARS.

Agriculture and Recruiting.

1. THE President of the Board of Agriculture and Fisheries is receiving a large number of enquiries from farmers and other agriculturists as to the effect on agriculture of Lord Derby's recruiting scheme, and the following statement has been prepared in answer to such enquiries:—

2. Certain classes of skilled agricultural workers have been starred in connection with the National Register. These will in no case be enlisted for immediate service with the Colours, even if they offer themselves for that purpose, but they can if they wish be attested, passed at once into Section B Army Reserve, grouped, and returned to their civil occupations. A man accepted on these conditions will be entitled as a soldier in the Reserve to wear a khaki armlet, which will be given to him by the Military Authorities. Men will be grouped in the Reserve in 46 classes according to their age and condition, *i.e.*, married or single, and the groups will be called up for service in order. Starred men will not be called up for service unless the Recruiting Officer appeals to the local tribunal appointed by the District Council on the ground that a particular man is improperly or unnecessarily starred. In such a case the local tribunal will investigate the case and report to the Central Appeal Committee, who will decide whether the man should be called up for service or not.

3. If any starred man has inadvertently been enlisted for immediate service with the Colours, the employer at once should notify the Secretary of the County War Agricultural Committee, and write to the War Office, who have undertaken to make every effort to return him to civil occupation.

4. In addition to the starred men there are the cases of certain men who have not been starred owing to mis-description or other causes. If such a man offers himself for enlistment the employer will have the right of appeal to the local tribunal and if it is decided that the man ought to have been starred he will be placed in the same position as a starred man.

5. There are also certain men who though not belonging to the starred classes are really indispensable on the farms or in the trades allied to agriculture. The farmer who manages a farm heads this list. If men who are really indispensable from the national point of view for the cultivation of the land feel impelled to offer themselves for military service, Lord Selborne strongly advises them not to enlist for immediate service, but to exercise their option of being attested and passed into the Reserve. This will ensure their present continuance in their civil occupation, and on each occasion that their group is called up an opportunity will be given through the local tribunals for consideration whether on national grounds their service should not be postponed to a later date.

6. The above arrangement should ensure that farmers and other agricultural employers shall keep their properly starred men, and that in the doubtful cases they shall not be denuded of labour without being afforded an opportunity of having those cases considered, and it will give them some time to engage and train women or other substitutes.

7. Farmers themselves, in common with other employers, have not been starred, but it is essential that at least one member of the farmer's family should remain to direct the business. Lord Selborne considers that farmers of military age who desire to join the Army should not enlist for immediate service, but be attested and passed into the Reserve.

8. Lord Selborne feels sure in view of the arrangements made for the retention of the skilled and indispensable men that farmers and other agricultural employers will encourage the immediate enlistment of men who are not really indispensable.

Autumn Dressings for Wheat.

THE Board of Agriculture and Fisheries wish to impress upon farmers the desirability of top-dressing wheat on soils of poor or medium quality with from ½ to 1 cwt. of sulphate of ammonia per acre during November or December.

A leaflet explaining the reasons for this recommendation, containing suggestions for the manuring of different soils, will be sent, post free, on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W.

In order to encourage the use of top-dressings the President of the Board of Agriculture and Fisheries, with the concurrence of the Secretary for Scotland, has come to an agreement with manufacturers of sulphate of ammonia in Great Britain who have agreed to reserve a definite proportion of their make in November and December for farmers' use. Under this arrangement farmers or agricultural merchants will be able to purchase sulphate of ammonia from the manufacturers for prompt cash, at not more than £14 10s. per ton, single bags free, free on rail at

works, net cash, in lots of not less than 10 cwt. each. This price relates to sulphate of ammonia containing 20·16 per cent. of nitrogen (= 24·5 per cent. of ammonia). Purchases made from merchants or agents, or upon other terms than those stated, must be at such price as may be agreed.

Farmers who desire to take advantage of these terms should place their orders with the manufacturers *early*, or they may find that the supply which has been reserved under this arrangement has been exhausted.

If a farmer or merchant finds himself unable to obtain supplies on the above terms, he should at once communicate with the Secretary to the Fertilisers Committee, 3, St. James's Square, London, S.W.

Transport of Goods by Rail.

IN view of the difficulties and delays which are liable to arise under present conditions in the transport of goods by rail, the Board of Agriculture and Fisheries recommend farmers to place their orders for feeding stuffs and other farm requirements so as to allow ample time for delivery.

Railway Companies are contending with great difficulties owing to the exceptional demands upon their rolling stocks, while prompt delivery by manufacturers is in many cases hampered by a shortage of labour. By placing their orders so as to allow ample time for delivery farmers will avoid inconvenience to themselves and will assist both the Railway Companies and the manufacturers.

Apple Pomace as a Feeding Stuff.

THE Board of Agriculture and Fisheries wish to draw the attention of stock keepers living in cider-making counties to the value of pressed apple pomace as a palatable feeding stuff for all kinds of stock. The fresh pomace, which contains from 70 per cent. to 80 per cent. of water, according to the efficiency of the pressing and the variety of apple, should be fed in combination with more concentrated feeding stuffs, and not as a complete ration in itself. On the basis of composition it has a considerably higher feeding value than mangolds, and is not unlike wet brewers' grains, though it contains less protein. As it ferments rapidly it should be fed quite fresh; or it may be preserved with salt and made into a kind of silage. When dried the pomace forms a valuable concentrated feeding stuff.

Committee on Supplies of Fertilisers.

THE President of the Board of Agriculture and Fisheries has appointed a Departmental Committee to make arrangements with a view to the maintenance, so far as possible, of adequate supplies of fertilisers for use of farmers in the United Kingdom.

The Committee is constituted as follows :—The Right Hon. F. D. Acland, M.P., Parliamentary Secretary to the Board of Agriculture and Fisheries, (*Chairman*); Mr. R. H. Rew, C.B. (Board of Agriculture and Fisheries), Mr. T. H. Middleton, C.B. (Board of Agriculture and Fisheries,) Mr. G. J. Stanley, C.B., C.M.G. (Board of Trade), Mr. J. Dundas White, M.P. (Scottish Office), Mr. H. Ross Skinner (Ministry of Munitions), Mr. E. J. Foley (Admiralty), Mr. R. J. Thompson (Board of Agriculture and Fisheries). *Secretary:* Mr. H. D. Vigor, 3, St. James's Square, London, S.W.

Distribution of Sittings of Eggs of Pure Breeds of Poultry.

THE Board of Agriculture and Fisheries have, with the concurrence of the Treasury and the Development Commissioners, asked the Local Education Authorities in certain selected counties to co-operate with them in a Scheme for the Distribution of Sittings of Eggs of *Pure Breeds of Poultry to Cottagers and Small* Holders. The Scheme is as follows :—

1. The Board are prepared to encourage the establishment of a limited number of stations for the distribution of sittings of eggs of pure-bred fowls to cottagers and small holders, the assessment of whose holding or holdings does not exceed £50 in the aggregate.

2. Applications from those who are willing to establish and maintain such stations may be made to the Agricultural Organiser for the county.

3. Preference will be given to applicants who are situated in the vicinity of groups of small holdings, and who are engaged in agriculture.

Selected applicants must comply with the following conditions :—

(1) Each station-holder will be required to provide approved stock consisting of not less than 24 pure-bred hens or pullets, and one pure-bred cock or cockerel for every 12 hens or pullets ; to dispose of any other birds on the holding, and to undertake not to introduce any poultry other than the approved stock without the Agricultural Organiser's permission. Save in exceptional circumstances only one breed of fowls should be maintained.

(2) The male birds used at the station must be replaced each year by males whose breeding and stamina are likely to secure and maintain vigour and fecundity in the offspring.

(3) One-third of the hens must be replaced each year by well-matured pullets.

(4) The birds must be housed and fed as the Agricultural Organiser may direct, and must be divided into suitable flocks for breeding purposes ; they must be provided with grass runs, allowing in cases where the runs are enclosed not less than 20 sq. yd. per bird.

(5) The station-holder will be required to supply sittings of 12 eggs to cottagers and small holders resident in the county from the 1st December to the 30th April in each year at 2*s.* per doz., including the provision of a suitable box for packing. *Carriage on the eggs must be paid by the purchaser.*

(6) All eggs sent out from the station must be stamped with a stamp provided by the Board.

(7) Orders received for eggs should be executed in rotation, and no applicant should be permitted to obtain more than 3 sittings of eggs in the season. Infertile eggs (if they are returned carriage paid) will be replaced.

(8) The station-holder will be required to keep an accurate record of the number of eggs laid during the season, and to record the name and address of each applicant to whom sittings are supplied and the date on which the eggs were despatched. A record book will be supplied for this purpose which must be submitted to the Board through the county organiser at the close of the season.

(9) The station-holder must permit officers of the Board or of the local authority to visit the station at any time, to inspect the stock, the method of management and the record book.

(10) Provided that *at least* 60 sittings of eggs are distributed to eligible applicants during the period from the 1st December to the 30th April, the station-holder will receive a subsidy of £5 when the Board are satisfied that the conditions of the scheme have been fulfilled. If a smaller number than 60 sittings of eggs is distributed the subsidy will be reduced proportionately.

(11) In all matters of dispute the decision of the Board shall be final.

Wart Disease of Potatoes.

THE following is a list of the potatoes recommended by the Board of Agriculture and Fisheries for planting on Infected Premises and Infected Areas in England and Wales for 1916:—

1. A1 (Sutton).
2. Conquest (Findlay).
3. Snowball (Carter).
4. Abundance (Sutton).
5. King Albert (Sands).
6. Leinster Wonder (Sands).
7. The Duchess (Dobbie).
8. Rob Roy (McAlister).
9. Great Scot (McAlister).
10. Southampton Wonder (Toogood).
11. Jennie Deans (Findlay).
12. Kerr's Pink.
13. Schoolmaster.
14. Crofter (Dobbie).
15. Culdees Castle (G. R. Sharp).
16. Provost (Dobbie).
17. The Admiral (Dobbie).
18. Irish Queen (Sands).
19. Shamrock (Sands).
20. St. Malo Kidney.
21. King George V. (Butler).
22. Laird (Davis).
23. Flourball (Sutton).
24. Golden Wonder (Brown).
25. Langworthy (Niven).
26. What's Wanted (Niven).
27. Burnhouse Beauty (Dobbie).
28. The Lochar (Farish).
29. White City (Sutton).

Employment on the Land of Sailors and Soldiers on Discharge from the Navy and Army.

THE Departmental Committee appointed by Lord Selborne under the chairmanship of Sir Harry Verney, Bart., M.P., to consider what steps can be taken to promote the settlement or employment on the land in England and Wales of sailors and soldiers, whether disabled or otherwise, on discharge from the Navy or Army, has presented an Interim Report recommending that, as an experiment, 50 men who have been discharged from the Navy or Army owing to disablement should be given a course of training in an Agricultural College, with a view to obtaining for them permanent employment on the land, and, in the case of those proving specially capable, fitting them to become occupiers of small holdings.

This recommendation has been approved by Lord Selborne and endorsed by the War Office, and the Treasury have agreed to place funds at the disposal of the Board of Agriculture and Fisheries to defray the cost of the experiment.

It is proposed that the men selected shall be sent to the Harper Adams Agricultural College, Newport, Salop, and to the College of Agriculture and Horticulture, Holmes Chapel, Cheshire, where they will be provided with board and lodging and be given a course of training in agriculture and horticulture free of charge to themselves. No deductions will be made from their disability pensions. In the first instance the course will extend over one term of about 12 weeks, at the end of which time those men whose conduct and work have been

satisfactory, and who seem capable of succeeding as small holders, will be given a further course extending over two more terms, so that they may receive instruction in the whole cycle of agricultural and horticultural operations. There should be no difficulty in obtaining satisfactory employment on farms for those men who are not retained for more than one term. During the course the men will be under the control of the Principal and subject to the ordinary rules of the College.

Any men who have been discharged from the Navy or Army on account of disablement, and who desire to receive this course of training, should apply at once to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, S.W., for a form of application.

Storage of Fruit.

OWING to the necessary demands of the Military Authorities on the railway companies serving some of the fruit-growing districts, it may be found that it would be contrary to the public interest that they should accept for transport the whole of the crop of apples and pears as picked. It may, therefore, be necessary for growers to store some part of their crop. Notes on the storage of fruit are included in the Board's Special Leaflet No. 6, which may be obtained on application at their offices at Whitehall Place, London, S.W.

If the apples or pears are ripe, or are inteuded for immediate consumption, the earliest possible notice that the fruit will be offered for carrage by rail should be given to the local officials of the Company concerned. In all such cases it is important that the quantity to be forwarded should be specified at the station from which it is proposed to consign the fruit.

Foot-and-Mouth Disease.

THE existence of foot-and-mouth disease amongst animals on premises at Monkton Combe, near Bath, Somerset, was confirmed on 21st October, 1915.

Precautions were at once taken to prevent the spread of the disease, and an Order was made prohibiting the movement of animals in a large area surrounding the iufected farm. Investigation showed, however, that the disease had been in existence some considerable time before it was detected and reported. It was not, therefore, a matter for surprise that the disease quickly appeared amongst animals on other premises in the neighbourhood which had been in contact with the diseased animals or on premises which were in close proximity thereto. In this way 37 further outbreaks of the disease have been confirmed in the same locality up to the 12th inst., and one upon premises at Hubberston, Angle, near Milford, *Pembrokeshire*, to which contact animals had been moved.

In the Pembrokeshire case, which was confirmed on the 28th ult., the movement of animals over an area surrounding the infected premises was, as a precautionary measure, at once prohibited. No further outbreak has since been reported in this district, and the Scheduled District has been considerably contracted and the restrictions on the movement of animals in the reduced area modified.

The Somerset Prohibition of Movement Order was modified on the

1st inst. to allow movement into and within an outer zone of the Scheduled District for slaughter, and again on the 8th inst. as regards a larger zone to allow movement by licence for any necessary purpose. Owing to outbreaks of the disease near Bristol the above-mentioned zone, in which movement by licence was allowed, was extended in the direction of the Bristol Channel to include an area not originally comprised within the Scheduled District.

Destruction of Foxes.

THE President of the Board of Agriculture and Fisheries, in view of the inevitable increase in the number of foxes consequent on the reduction or cessation of fox-hunting during the War, has drawn the attention of the Masters of Foxhounds Association to the desirability of adopting measures to destroy foxes, and the President of the Association has issued a letter urging Hunt Clubs throughout England and Wales to do their best in this manner to protect the interests of farmers and poultry-keepers. Lord Selborne has also arranged for enquiry by his Department as to the extent to which the surplus of foxes is being reduced, and to what degree their depredations are still affecting the actual and potential supply of food.

This information will be placed at the disposal of the County War Agricultural Committees and the District Sub-Committees in order that additional consideration may be given to the protection of poultry in localities where the results of the enquiry indicate that such a course is desirable.

Third Year-Book of Agricultural Statistics.

THE International Institute of Agriculture has just published, in French, the Third International Year-Book of Agricultural Statistics (*Annuaire International de Statistique Agricole* 1913 *et* 1914). It is the intention of the Institute to issue this volume every two years. The first Year-Book appeared in 1912 and related to the decennial period 1901–1910; the second Year-Book, issued at the beginning of 1915 dealt with the period 1903–1912. The present volume is a collection of statistical tables, systematically grouped, giving the following particulars for the countries throughout practically the whole of the civilised world in the decennial period 1905–1914:—(1) Total area and population; (2) Area and production of principal crops; (3) Numbers of live stock; (4) Importation and exportation of agricultural produce; (5) Consumption and prices of agricultural produce; (6) Trade in artificial manures. The last is a new section in the Year-Book.

The figures for all countries are expressed in the same measures, and grouped into concise and intelligible tables, so as to enable the reader to form an opinion of the evolution of agriculture either in individual countries or in practically the whole world.

The Year-Book may be obtained from the Board of Agriculture and Fisheries, Whitehall Place, London, S.W., price 4*s.*, post free.

The attention of readers of this *Journal* is drawn to Leaflet No. 257, which gives some account of the work, aims, and publications of the International Institute of Agriculture. With regard to the Institute's publications, these are on sale at the Office of the Board, and particulars as to prices will be found in the Leaflet, copies of which may be obtained free on application.

Increasing the Production of Home-Grown Food.

THE following circular letter, dated 14th October, 1915, has been issued to the secretaries of the County War Agricultural Committees:—

SIR,—I am directed by the President of the Board of Agriculture and Fisheries to enclose herewith for the information of the County War Agricultural Committee, 30 copies of a statement * of the acreage under Clover and Rotation Grasses, other arable land and permanent pasture in each County in the years 1875, 1885, 1895, 1905 and 1915.

Lord Selborne hopes that the figures relating to your County will be of service to the Committee in considering the extent to which it may be possible to secure an increase of the arable area.

Additional copies of the statement will be supplied on application.

Statements are in preparation showing the acreage under each separate crop in the current year in each County and in each Petty Sessional Division, and copies of these will be supplied to you as soon as possible.

I am, etc.,
SYDNEY OLIVIER, *Secretary*.

Produce of Hops.

PRELIMINARY STATEMENT showing the estimated total production of hops in the years 1915 and 1914, with the acreage and estimated average yield per statute acre in each county of England in which hops were grown.

COUNTIES, &c.	Estimated Total Produce.		Acreage Returned on 4th June.		Estimated Average Yield per Acre.	
	1915.	1914.	**1915.**	1914.	**1915.**	1914.
	Cwt.	Cwt.	Acres.	Acres.	Cwt.	Cwt.
KENT East ...	**54,819**	94,877	**5,727**	6,174	**9·57**	15·37
KENT Mid. ...	**68,361**	104,405	**7,184**	7,604	**9·52**	13·73
KENT Weald ...	**65,646**	119,422	**8,370**	8,848	**7·84**	13·50
Total, Kent	**188,826**	318,704	**21,281**	22,626	**8·87**	14·09
HANTS	**6,131**	22,262	**1,514**	1,580	**4·05**	14·09
HEREFORD	**20,737**	70,478	**5,405**	5,507	**3·84**	12·80
SURREY	**1,628**	8,188	**552**	585	**2·95**	14·00
SUSSEX	**22,173**	43,980	**2,864**	3,036	**7·74**	14·49
WORCESTER ...	**14,469**	42,238	**2,961**	3,194	**4·89**	13·22
OTHER COUNTIES† ...	**137**	1,408	**113**	133	**1·21**	10·59
TOTAL	**254,101**	507,258	**34,690**	36,661	**7·32**	13·84

NOTE.—The total production of hops in 1915, viz., 254,101 cwt., is practically half the amount produced last year, and almost identical with the total production of 1913. The yield per acre, 7⅓ cwt., is not quite 2½ cwt. below the average of the ten years 1905–14, viz., 9·73 cwt.

---

* Not printed.

† Gloucester, Salop and Stafford.

Produce of Corn, Pulse and Hay Crops in England and Wales in 1915.

ON 5th November the Board issued the following preliminary statement showing the estimated total produce and yield per acre of the corn, pulse, and hay crops in England and Wales in the year 1915, with comparisons for 1914, and the average yield per acre of the 10 years 1905–1914.

—	Crops.	Estimated Total Produce.		Acreage.		Average Estimated Yield per acre.		Average of the Ten Years 1905-1914.
		1915.	1914.	1915.	1914.	1915.	1914.	
ENGLAND AND WALES.		Quarters.	Quarters.	Acres.	Acres.	Bush.	Bush.	Bush.
	Wheat ..	8,490,692	7,307,036	2,170,170	1,807,498	31·30	32·34	32·02
	Barley ..	4,558,069	6,173,948	1,231,714	1,504,771	29·60	32·82	33·18
	Oats ..	10,452,128	9,553,727	2,088,009	1,929,617	40·05	39·61	40·22
	Beans ..	894,599	1,083,702	257,655	284,371	27·78	30·49	30·28
	Peas ..	299,226	372,387	98,265	129,528	24·36	23·00	26·39
		Tons.	Toos.			Cwt.	Cwt.	Cwt.
	Seeds Hay*	2,287,703	2,117,137	1,538,067	1,554,907	29·75	27·23	28·87
	Meadow Hay†	4,299,354	5,148,241	4,651,609	4,785,451	18·49	21·52	23·25
ENGLAND		Quarters.	Quarters.			Bush.	Bush	Bush.
	Wheat ..	8,319,257	7,175,950	2,121,519	1,770,470	31·37	32·43	32·13
	Barley ..	4,257,621	5,841,499	1,151,536	1,420,346	29·58	32·90	33·32
	Oats ..	9,565,833	8,653,284	1,888,530	1,730,082	40·52	40·01	40·76
	Beans ..	891,098	1,079,369	256,635	283,194	27·78	30·49	30·30
	Peas ..	298,266	371,183	97,929	129,116	24·37	23·00	26·41
		Tons.	Tons.			Cwt.	Cwt.	Cwt.
	Seeds Hay	2,080,215	1,906,381	1,372,922	1,390,898	30·30	27·41	29·25
	Meadow Hay	3,807,457	4,603,527	4,118,843	4,239,074	18·49	21·72	23·62
WALES ..		Quarters.	Quarters.			Bush.	Bush.	Bush.
	Wheat ..	171,435	131,086	48,651	37,028	28·19	28·32	27·57
	Barley ..	300,448	332,449	80,178	84,425	29·98	31·50	31·06
	Oats ..	886,295	900,443	199,479	199,535	35·54	36·10	35·26
	Beans ..	3,501	4,333	1,020	1,177	27·46	29·45	27·33
	Peas ..	960	1,204	336	412	22·86	23·38	22·95
		Tons.	Tons.			Cwt.	Cwt.	Cwt.
	Seeds Hay	207,488	210,756	165,145	164,009	25·13	25·70	25·60
	Meadow Hay	491,897	544,714	532,766	546,377	18·47	19·94	20·25

* Hay from Clover, Sainfoin, and Grasses under rotation.
† *Hay from Permanent Grass.*

NOTE.—The total production of wheat in England and Wales—8,490,692 qr.—is 1,180,000 qr. more than in 1914 when the area under this crop was 363,000 acres less, and is the largest since 1898. The yield this year is one bush. per acre less than in 1914, and nearly ¾ of a bush. below the average of the ten years 1905–14. The total production of barley is much the lowest recorded, as a consequence of a greatly decreased acreage, coincident with a poor average yield per acre; the latter is 3¼ bush. under that of last year, and 3½ bush. under the ten years' average. Oats have yielded a little more per acre than last year, and are only slightly under the average, and owing to an increased acreage the total production is 900,000 qr. more than last year, and is the highest since 1910. Beans are 2½ bush. per acre under the average, and on a decreased acreage the total yield of 895,000 qr. is the lowest since 1904. The total production of peas harvested is just under 300,000 qr.; the yield per acre is 1⅓ bush. above the very poor crop of 1914, but is 2 bush. under the average. The production of hay from clovers and rotation grasses is considerably more than was anticipated early in the season, the yield of the second cut being in many cases equal to or even better than that of the first; the yield per acre is nearly 1 cwt. above the average, and 2½ cwt. above last year. Meadow hay, on the other hand, is 4¾ cwt. per acre below average. The total production of both kinds of hay amounts to 6,600,000 tons, which, with the exception of the very poor crop of 1911, is the smallest since 1901.

The estimate of the hop crop was issued on the 15th ult.; the returns of the production of potatoes and roots are collected at a later date, and will be issued subsequently.

Notes on Crop Prospects and Live Stock Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for October, 1915, issued by the International Institute of Agriculture, contains estimates of the production of cereal crops in the Northern Hemisphere this year. The countries for which it is possible to give approximate estimates are as follows:—In *Europe*—Hungary, Denmark, Spain, France, Great Britain, Ireland, Italy, Luxemburg, Norway, Netherlands, Rumania, Russia in Europe (54 Governments), Switzerland; in *America*—Canada, United States; in *Asia*—India, Japan, Russia in Asia (10 governments in 1915 and 9 governments in 1914); in *Africa*—Egypt, Tunis.

Wheat.—The total production in the above-mentioned countries is estimated to amount to 451,233,000 qr. in 1914–15, against 372,052,000 qr. in 1913–14, or an increase of 21·3 per cent., while the area under cultivation was also greater by 6·8 per cent.

Rye.—In the same countries as above, excluding Great Britain, India, Japan, Egypt, and Tunis, the total production is estimated at 137,129,000 qr. in 1914–15, against 119,503,000 qr. in 1913–14, or an increase of 14·7 per cent. The area sown, however, was less by 0·4 per cent.

Barley.—For the specified countries, excluding India, the estimated production is placed at 145,983,000 qr. in 1914–15, as compared with 125,260,000 qr. in 1913–14, the increase being equal to 16·5 per cent. The area planted showed a decrease of 1·2 per cent.

Oats.—The total production in the above countries, excluding India, Japan, and Egypt, is estimated at 395,126,000 qr. in 1914–15, against 321,733,000 qr. in 1913–14, or an increase of 22·8 per cent., while the area under cultivation was greater by 1·1 per cent.

Maize.—In Italy, Rumania, Russia in Europe (54 governments), Switzerland, Canada, United States, Japan, and Russia in Asia (10 governments in 1915 and 9 governments in 1914), the total production is estimated at 390,498,000 qr. this year, against 348,300,000 qr. last year, or an increase of 12·1 per cent., the area under cultivation showing an increase of 5·9 per cent.

New Zealand.—The preliminary figures for 1914–15 give the production of wheat at 686,000 qr. against 654,000 qr. in 1913–14, or an increase of 4·9 per cent., while the area under cultivation was greater by 13·7 per cent. The production of barley decreased 50·5 per cent., being 75,000 qr against 151,000 qr. in 1913–14; the area sown was less than in 1913–14 by 42·7 per cent. The production of oats is estimated at 1,429,000 qr. against 1,842,000 qr. in 1913–14, or a decrease of 22·4 per cent., the area sown decreasing 20·5 per cent., while maize is estimated at 33,000 qr. against 39,000 qr. in 1913–14, a decrease of 15·7 per cent., the area under cultivation decreasing by a like percentage.

France.—The condition of potatoes on the 1st October was officially estimated at 52 as compared with 53 on the 1st September, and of maize at 64 against 68. (80 = good, 60 = fairly good, and 50 = passable). (The *London Grain, Seed and Oil Reporter*, 28th October.)

United States.—The Crop Reporting Board of the Bureau of Statistics of the Department of Agriculture states that the total yield of maize is estimated at 3,091,000,000 bush. as compared with 2,705,692,000 bush. last year, with an average quality of 90·3 against 85·1 in 1914. The quantity of old maize estimated to be in farmers' hands on November 1st was 96,001,000 bush. The yield of linseed is estimated at 18,000,000 bush. as compared with 15,973,000 bush. last year, and the quality at 99·3 against 90·4 in 1914. The average weight of wheat per bush. is estimated at 57·9 lb. against 58·0 lb. last year; of oats 33·0 lb. against 31·5 lb.; and of barley 47·4 lb. against 46·2 lb. in 1914. (The *London Grain, Seed and Oil Reporter*, 8th November.)

Russia.—The official "Trade Gazette" of Petrograd of 25th September (8th October) gives, from data of the All-Russian Sugar Refiners' Society, the area under sugar-beet as 1,747,660 acres against 1,853,806 acres last year, and the total production (exclusive of the yield in Russian Poland, now under German occupation) is estimated at 11,812,200 tons as compared with 12,155,758 tons in 1914.

Canada.—According to a report issued by the Census and Statistics Office at Ottawa, the yield of the crops is estimated as follows:—Wheat 336,258,000 bush., an increase of 174,978,000 bush. as compared with last year; oats 481,035,500 bush. against 311,426,000 bush.; barley 50,868,000 bush. against 34,591,000 bush.; and rye 2,478,500 bush. against 2,258,000 bush. The average quality of the crops ranges between 90 and 93 per cent. of a standard crop.

Argentina.—According to the preliminary official estimate the areas sown with the crops are as follows (in acres):—Wheat 16,321,000 as compared with 15,464,000 in 1914; linseed 4,058,000 against 4,255,000; and oats 2,630,000 against 2,865,000. (The *London Grain, Seed and Oil Reporter*, 20th October.)

South Australia.—The area sown with wheat is officially reported to be 10 per cent. in excess of last year's acreage, and the prospective yield is estimated at 29 million bush., or 4 million bush. larger than the previous record (The *London Grain, Seed and Oil Reporter*, 22nd October.)

Hops.—*United States.*—His Majesty's Consul at Portland, Oregon, in a report, dated 27th September, stated that the hop crop in Oregon was estimated at 90,000 to 100,000 bales, in Washington at 35,000 bales, in California at 125,000 bales, and in the State of New York at 10,000 bales, making a total crop for the United States of 260,000 to 270,000 bales. It was estimated that there were about 5,000 bales in stock throughout the country from last season's crop. The prices ruling at the date of the report were from 5*d.* to 6*d.* per lb., being considerably lower than usual owing to abnormal conditions.

Live Stock in France.—The number of horses on 1st July, 1915, was 2,227,209, against 3,230,700 on 31st December, 1913; while cattle totalled 12,286,849, against 14,807,380; sheep 13,483,189, against 16,213,030, and pigs 5,490,796, against 7,047,750. (*Bulletin of Agricultural and Commercial Statistics*, October, 1915.)

Live Stock in Canada.—Horses numbered 2,996,099 on 30th June, 1915, against 2,947,738 on the same date in the previous year, or an increase of 1·6 per cent. Milk cows totalled 2,666,846 against 2,673,286,

or a decrease of 0·2 per cent., but other cattle showed an increase of 1·1 per cent., the total being 3,399,155 in 1915 against 3,363,531 in 1914. Sheep decreased 0·9 per cent., there being 2,038,662 in 1915 as compared with 2,058,045 in 1914, while pigs also showed a decrease, amounting to 9·4 per cent., the total for 1915 being 3,111,900 against 3,434,261 in 1914. (*Bulletin of Agricultural and Commercial Statistics*, October, 1915.)

Live Stock in New Zealand.—The "Second Interim Return of Sheep in the Dominion" for the year ended 30th April, 1915, gives the number of sheep as 24,824,394, against 24,798,763 in the preceding year, or an increase of 0·1 per cent. (*Bulletin of Agricultural and Commercial Statistics*, October, 1915.)

Agricultural Conditions in England and Wales on 1st November.

THE reports furnished by the Crop Reporters of the Board on agricultural conditions in England and Wales indicate that, on the whole, the corn crops were secured in good condition. Wheat is of good quality generally, and is better than the other two cereals. The quality of barley and oats is variable, and in the Eastern Counties especially is somewhat inferior. Barley is frequently reported to be discoloured.

The bulk of the potato crop has now been lifted, under favourable conditions. Disease is reported from most parts of the country, but with few and unimportant exceptions the attacks are not serious.

The lifting of the mangold crop is mostly well advanced; the roots are reported to be sound generally, but often small. Turnips and swedes are still making growth, and although also small, at present promise to be a sound crop in most parts; very few have yet been lifted. Seeds, with few exceptions, are very promising.

Autumn cultivation is in many districts not so forward as usual, ploughing having been delayed by the hardness of the ground, and also, in many cases, by the shortage of labour. In other districts, more especially in the south-western and northern counties, good progress has been made, and a fair proportion of the wheat sown.

Live stock have done well during October. In most parts the pastures are still showing a fair supply of grass. The outlook for winter keep, however, is in many cases not altogether satisfactory; the yield of hay was, on the whole, short, and the root crops will probably be somewhat deficient.

Agricultural Labour in England and Wales during October.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st November, the supply of labour in England and Wales during October continued to be short in all parts of the country, and the deficiency hindered autumn cultivation in a number of districts.

The following local summaries give further details regarding agricultural labour in the different districts of England and Wales:—

Northumberland, Durham, Cumberland and Westmorland.—In some districts the shortage in the supply of labour was being keenly felt, and casual labour for potato lifting was often scarce. On the whole, however, farm work was about as forward as usual.

Lancashire and Cheshire.—There was a general shortage of labour throughout the district, but the deficiency was partially made up by resort to female and boy labour, and the fine weather materially assisted the autumn work. It was feared that the difficulty may become more acute after the November hirings.

Yorkshire.—Labour was deficient is most districts. Casual labour was more plentiful, but permanent labourers were very scarce.

Shropshire and Stafford.—Labour was scarce, particularly temporary hands, and in south-east Stafford stockmen and horsemen were difficult to obtain.

Derby, Nottingham, Leicester, and Rutland.—Labour was still deficient everywhere, but the fine weather during October eased the position.

Lincoln and Norfolk.—Labour was everywhere very short, but the weather helped matters, and women have been employed as far as possible.

Suffolk, Cambridge, and Huntingdon.—Labour was still scarce and wages high. The scarcity of labour was most notable where threshing was in progress.

Bedford, Northampton, and Warwick.—Labour still appeared to be scarce everywhere, and more enlistments were reported to have taken place.

Buckingham, Oxford, and Berkshire.—The supply of labour was deficient everywhere, but the weather was such that it was possible to carry out operations with a minimum supply. Womeu and children have been assisting in some districts.

Worcester, Hereford, and Gloucester.—Labour was still scarce, owing to the increased enlistment of men for the Army.

Cornwall, Devon, and Somerset.—The supply of labour was everywhere short, and in Somerset the scarcity was being severely felt. Threshing was being done by co-operation between neighbours. In some districts it was said to be impossible to get women to work in the fields.

Dorset, Wiltshire, and Hampshire.—Labour was generally very deficient. Skilled labour was particularly scarce, and the difficulty was being met by omitting all but indispensable operations and resorting to female labour, especially for milking and root lifting.

Surrey, Kent, and Sussex.—Labour was still scarce, but the shortage of labour had not been very seriously felt owing to the favourable weather.

Essex, Hertford, and Middlesex.—The supply of labour was very deficient, but women have been freely employed in lifting potatoes and roots. Complaint was made of the dearness of labour in south-east Herts and central Middlesex.

North Wales.—The supply of labour was short, but generally proved sufficient.

Mid-Wales.—The supply proved sufficient for requirements in most districts, but in one or two places casual labourers were difficult to obtain.

South Wales.—Labour was generally scarce, especially temporary hands for potato and root lifting.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st November, 1915, certain diseases of animals existed in the countries specified :—

Austria (on the 13th Oct.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (month of Sept.).
Anthrax, Foot-and-Mouth Disease (178 outbreaks), Swine Erysipelas, Swine Fever.

France (for the period 3rd—16th Oct.).
Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders and Farcy, Pleuro-pneumonia, Rabies, Swine Erysipelas, Swine Fever.

Germany (for the period 1st—15th Oct.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (month of Sept.).
Anthrax, Foot-and-Mouth Disease (88 outbreaks), Foot-rot, Swine Erysipelas.

Hungary (on the 13th Oct.).
Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox, Swine Erysipelas, Swine Fever.

Italy (for the period 11th—17th Oct.).
Anthrax, Blackleg, Foot-and-Mouth Disease (3,085 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosis.

Norway (month of Sept.).
Anthrax, Blackleg, Swine Fever.

Rumania (for the period 21st—29th Sept.).
Anthrax, Foot-and-Mouth Disease, Glanders and Farcy, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Russia (month of June).
Anthrax, Foot-and-Mouth Disease (397,356 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (month of Aug.).
Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (month of Sept.).
Anthrax, Blackleg, Foot-and-Mouth Disease, Swine Erysipelas.

Switzerland (for the period 18th—24th Oct.).
Anthrax, Blackleg, Foot-and-Mouth Disease (7 "étables" entailing 110 animals, of which 3 "étables" were declared infected during the period), Swine Fever.

No further returns have been received in respect of the following countries :—Belgium, Bulgaria, Montenegro, Serbia.

The Weather in England during October.

District.	Temperature.		Rainfall.				Bright Sunshine.	
	Daily Mean.	Diff. from Average.	Amount.		Diff. from Average.	No. of Days with Rain.	Daily Mean.	Diff. from Average.
Week ending Oct. 2nd :	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours
England, N.E. ...	46·7	−5·6	0·39	10	0	3	5·4	+1·5
England, E.	48·3	−5·3	0·95	24	+11	4	4·1	−0·3
Midland Counties ...	46·8	−5·6	0·44	11	− 3	3	3·9	0·0
England, S.E.... ...	48·6	−6·4	1·33	34	+18	3	3·2	−1·2
England, N.W. ...	47·3	−5·6	0·17	4	−17	3	4·5	+0·8
England, S.W. ...	49·5	−4·8	1·04	26	+ 3	5	2·6	−1·5
English Channel ...	53·4	−4·1	1·15	29	+ 9	6	2·7	−2·5
Week ending Oct. 9th :								
England, N.E.... ...	49·5	−0·9	0·06	2	−11	1	2·4	−1·3
England, E.	50·7	−0·8	0·24	6	− 9	3	3·0	−1·0
Midland Counties ...	49·0	−1·3	0·03	1	−15	1	1·4	−2·0
England, S.E.... ...	51·2	−1·7	0·10	3	−15	2	2·8	−1·1
England, N.W. ...	50·2	−0·9	0·15	4	−20	1	2·7	−0·5
England, S.W. ...	51·3	−1·1	0·37	9	−16	1	2·8	−1·0
English Channel ...	54·1	−1·6	0·43	11	−11	1	3·8	−0·7
Week ending Oct. 16th :								
England, N.E. ...	52·5	+3·7	0·19	5	−12	2	2·7	−0·7
England, E.	55·0	+5·2	0·04	1	−15	1	3·0	−0·6
Midland Counties ...	52·8	+4·2	0·11	3	−14	2	1·6	−1·7
England, S.E... ...	54·9	+3·8	0·06	2	−16	2	2·3	−1·3
England, N.W. ...	52·7	+3·1	0·37	10	−14	3	3·7	+0·8
England, S.W. ...	54·4	+3·5	0·32	8	−18	5	3·1	−0·4
English Channel ...	56·0	+1·7	0·13	3	−19	3	4·2	0·0
Week ending Oct. 23rd :								
England, N.E. ...	47·7	+0·2	0·22	6	−13	3	1·3	−1·8
England, E.	49·3	+1·0	0·31	8	− 9	3	2·2	−1·1
Midland Counties ...	46·6	−0·6	0·52	13	− 4	2	0·8	−2·2
England, S.E.... ...	50·0	+0·3	0·62	16	− 3	3	1·9	−1·5
England, N.W. ...	48·2	−0·1	0·48	12	−10	2	2·0	−0·7
England, S.W. ...	49·4	−0·3	1·40	36	+10	4	3·1	−0·2
English Channel ...	52·8	−0·4	0·89	23	0	4	2·7	−1·3
Week ending Oct. 30th :								
England, N.E. ..	43·7	−2·7	0·82	21	+ 2	5	1·6	−1·1
England, E.	45·5	−1·6	0·86	22	+ 6	5	1·5	−1·5
Midland Counties ...	43·6	−2·5	0·92	24	+ 7	4	2·0	−0·5
England, S.E.... ...	46·0	−2·6	1·31	33	+13	4	1·8	−1·2
England, N.W. ...	44·5	−2·7	0·79	20	− 2	4	2·7	+0·2
England, S.W. ...	46·0	−2·8	1·67	42	+16	5	3·6	+0·7
English Channel ...	49·6	−2·7	1·37	35	+12	6	3·7	+0·3

* 1 inch = 25·4 millimetres.

Unit Prices of Artificial Manures.

Statement of cost to the purchaser of 1 per cent. per ton of Nitrogen, Soluble and Insoluble Phosphates, and Potash derived from

	London.	King's Lynn.	Hull.	Newcastle.
	s. d.	*s. d.*	*s. d.*	*s. d.*
Nitrogen from:				
*Sulphate of Ammonia pure ... 95%	16 0	—	15 9	—
*Sulphate of Ammonia pure ... 93%	—	15 9	15 7½	—
Calcium Cyanamide ...	—	—	14 0½	—
Nitrate of Soda pure 95%	—	20 0	20 0	—
Nitrate of Soda pure 90%	19 10	—	20 0	—
Nitrate of Lime ..	—	—	—	—
Soluble Phosphates from:				
Superphosphate 35%	2 6½	2 2	2 6½	2 11
,, 33%	2 6½	2 3	2 7	—
,, 30%	2 7½	2 4	2 8½	3 1
,, 26%	2 10½	2 6	2 10½	3 4½
Dissolved Bones	3 9½	3 4	3 7	3 9
Allowed for Nitrogen	*19 6½*	*17 1*	*18 7*	*19 3*
Allowed for Insol. Phos.	*2 1½*	*1 10½*	*2 0½*	*2 1*
Insoluble Phosphates (Citric Soluble) from:				
Basic Slag	2 2	2 0½	1 10	—
Insoluble Phosphates from:				
Basic Slag	—	—	—	—
Bone Meal	1 10½	1 11	1 8½	1 10
Allowed for Nitrogen	*17 0*	*17 4½*	*15 8*	*16 9*
Steamed Bone Flour ...	1 9½	1 9½	1 11	—
Allowed for Nitrogen	*16 6½*	*16 7½*	*18 1½*	—
Potash from:				
Kainit	—	—	—	—
Sulphate of Potash ...	—	—	—	—
Muriate of Potash ...	—	—	—	—
Potash Salts	—	—	—	—

NOTE.—These unit prices are based on the *probable* retail cash prices in bags f.o.r. for quantities of not less than 2 tons of the manures mentioned at the ports and places specified, but it should be borne in mind that market prices are fluctuating considerably at the present time. The prices are published by the Board of Agriculture and Fisheries for use in comparing the commercial values of artificial manures. They may also be used as a guide to the probable price per ton of any of the manures mentioned if the unit prices of the constituents of the

* *By a special arrangement made with the Sulphate of Ammonia Association, farmers will be able to purchase a certain amount of sulphate of ammonia from manufacturers for £14 10s. per ton, in bags, net cash, delivered in lots of not less than 10 cwt., f.o.r. at the makers' works These terms apply to sales of a quantity*

various sources, at certain ports and Manufacturing Centres, for November, 1915.

Silloth.	Liverpool.	Widnes.	Newport.	Bristol.	Plymouth.
s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
—	—	15 6	15 6	—	—
—	15 8½	15 8	—	15 3½	15 11½
—	13 4½	—	—	—	14 3½
—	18 5½	18 8½	—	19 0½	18 8½
—	—	—	20 0	19 8	19 4
—	—	—	—	—	—
2 11	2 8½	2 7½	2 5½	2 5½	2 7
—	2 9½	2 8½	2 6½	2 6½	2 7
3 1	2 10½	2 9½	2 7½	2 7½	2 7½
3 4½	3 2	3 1	2 10½	2 10½	2 10½
3 10½	4 3	4 3	3 10	3 11	3 10½
19 11	*21 9½*	*22 1½*	*19 9*	*20 2½*	*19 10*
2 2	*2 4½*	*2 5*	*2 2*	*2 2½*	*2 2*
—	1 11	—	—	2 3½	2 6
—	—	—	—	—	1 10
2 0½	1 11	1 11	1 8	1 8½	1 10½
18 7½	*17 7½*	*17 3½*	*15 2½*	*15 10½*	*17 3*
—	—	—	*1 7½*	*1 9*	—
—	—	—	*14 8½*	*16 2½*	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—

manure are multiplied by the percentages of the constituents found in it, and due allowance is made for the difference between cash prices and credit prices, and for cost of carriage from the nearest centre to the place where it is delivered to the purchaser. If used in connection with the valuation of a compound manure regard must be had to the sources of the constituents, and a reasonable sum must be added for mixing, disintegrating and rebagging the ingredients, bags, and loss of weight.

reserved for autumn use, and hold during November and December, so long as the reserved quantity remains unsold The price stated is for sulphate of ammonia containing 20·16 N. The unit price, therefore, works out at 14s. 4½d.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	OCTOBER.		TEN MONTHS ENDED OCTOBER.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	35	63	477	620
Animals attacked	40	67	543	679
Foot-and-Mouth Disease:—				
Outbreaks	21	2	21	24
Animals attacked	115	16	115	124
Glanders (including Farcy):—				
Outbreaks	5	5	41	86
Animals attacked	8	16	74	265
Parasitic Mange:—				
Outbreaks	74	†—	*702	†1,530
Animals attacked	155	†—	*1,509	†2,642
Sheep-Scab:—				
Outbreaks	2	4	166	159
Swine Fever:—				
Outbreaks	287	525	3,450	3,682
Swine Slaughtered as diseased or exposed to infection ...	1,017	4,440	14,937	35,508

* Figures for seven months only. † The Parasitic Mange Order of 1911 was suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	OCTOBER.		TEN MONTHS ENDED OCTOBER.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	—	—	1	1
Animals attacked	—	—	1	1
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	76
Animals attacked	—	—	—	957
Glanders (including Farcy):—				
Outbreaks	—	—	1	—
Animals attacked	—	—	3	—
Parasitic Mange:—				
Outbreaks	6	4	64	71
Sheep-Scab:—				
Outbreaks	31	27	346	434
Swine Fever:—				
Outbreaks	26	17	219	178
Swine Slaughtered as diseased or exposed to infection ...	156	38	1,256	880

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in October and September, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	October.		September.	
	First Quality.	Second Quality.	First Quality.	Second Quality.
FAT STOCK :—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle :—	s. d.	s. d.	s. d.	s. d.
Polled Scots	11 4	10 8	12 4	11 4
Herefords	11 10	10 9	12 8	11 7
Shorthorns	11 8	10 7	12 7	11 6
Devons	11 11	10 5	12 9	11 9
Welsh Runts	11 6	10 8	12 5	11 9
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	10½	9¼	10⅛	9½
Sheep :—				
Downs	10¾	9¾	11	10
Longwools	10	9	10¼	9⅛
Cheviots	11	9¾	11¼	10¼
Blackfaced	10	9	10½	·9⅛
Welsh	9	8¾	10	9⅛
Cross-breds	10¾	9⅛	11	10
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs :—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	10 6	9 10	10 4	9 9
Porkers	11 3	10 7	10 9	10 3
LEAN STOCK :—	per head.	per head.	per head.	per head.
Milking Cows :—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	27 15	22 15	27 5	22 10
,, —Calvers ...	26 13	22 1	25 13	21 7
Other Breeds—In Milk ...	25 19	20 6	25 3	19 16
,, —Calvers ...	21 10	19 15	20 0	18 10
Calves for Rearing	3 1	2 6	3 3	2 7
Store Cattle :—				
Shorthorns—Yearlings ...	13 2	11 3	13 17	11 17
,, —Two-year-olds...	18 7	16 7	20 6	17 10
,, —Three-year-olds	24 5	20 9	25 17	22 6
Herefords —Two-year-olds...	20 16	16 15	21 6	18 7
Devons— ,,	18 10	15 6	20 2	17 4
Welsh Runts— ,,	19 10	16 19	20 14	19 6
Store Sheep :—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	48 3	40 3	46 10	39 8
Store Pigs :—				
8 to 12 weeks old	28 1	22 0	28 11	23 3
12 to 16 weeks old	45 11	35 8	46 0	35 3

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in October, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham. s.	Birmingham. d.	Leeds. s.	Leeds. d.	Liverpool. s.	Liverpool. d.	London. s.	London. d.	Manchester. s.	Manchester. d.
		per cwt.		per cwt.		per cwt.		per cwt.		per cwt.	
BEEF :—											
English ...	1st	76	0	75	0	—		76	6	74	0
	2nd	72	6	71	0	—		71	6	70	0
Cow and Bull ...	1st	67	0	68	0	66	0	66	6	66	6
	2nd	64	0	63	6	61	0	62	0	62	6
Irish: Port Killed ...	1st	70	0	71	0	71	6	74	0	71	0
	2nd	65	6	69	0	67	0	69	6	67	0
Argentine Frozen—											
Hind Quarters ...	1st	70	6	—		70	0	72	6	70	0
Fore " ...	1st	62	6	—		63	0	58	6	63	0
Argentine Chilled—											
Hind Quarters ...	1st	80	0	74	6	76	6	77	6	76	6
Fore " ...	1st	61	6	59	0	59	6	59	6	59	6
Australian Frozen—											
Hind Quarters ...	1st	71	6	69	0	66	6	70	0	66	6
Fore " ...	1st	62	0	63	6	60	6	60	6	61	0
VEAL :—											
British ...	1st	—		—		—		86	6	—	
	2nd	79	6	—		—		77	0	—	
Foreign...	1st	—		—		—		—		—	
MUTTON :—											
Scotch ...	1st	—		—		92	0	92	0	92	0
	2nd	86	6	—		87	6	86	6	89	0
English...	1st	88	6	89	0	84	0	87	0	89	0
	2nd	84	0	84	0	74	6	80	6	85	0
Irish: Port Killed ...	1st	86	6	—		83	6	81	6	85	0
	2nd	84	0	—		78	0	76	6	81	0
Argentine Frozen ...	1st	59	0	59	6	56	0	63	6	56	0
Australian " ...	1st	56	6	57	6	53	6	58	6	54	0
New Zealand " ...	1st	—		—		—		70	0	—	
LAMB :—											
British ...	1st	88	6	89	0	88	6	92	6	92	0
	2nd	85	0	84	0	79	6	85	6	88	6
New Zealand ...	1st	80	0	79	6	79	6	77	6	79	6
Australian ...	1st	73	0	70	0	69	6	72	6	69	6
Argentine ...	1st	73	6	72	6	71	6	70	6	71	6
PORK :—											
British ...	1st	97	0	88	6	94	6	101	6	95	0
	2nd	91	0	84	0	87	6	92	0	90	6
Foreign...	1st	—		—		—		—		—	

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in October, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Bristol.		Liverpool.		London.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	19 0	17 0	—	—	19 0	18 0
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	171 6	167 0	173 0	168 6	175 6	170 0
,, Factory	144 6	137 0	145 0	137 0	149 6	141 6
Danish...	—	—	191 6	187 0	190 6	185 6
French...	—	—	—	—	162 0	156 0
Russian	142 6	135 6	—	138 0	141 6	135 6
Australian	—	—	—	—	—	—
New Zealand	—	—	—	—	—	—
Argentine	—	—	—	—	—	—
CHEESE:—						
British—						
Cheddar	93 0	84 0	94 0	92 0	95 0	87 0
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	98 0	94 6	99 6	93 6
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	82 0	78 6	82 6	78 6	80 0	77 6
BACON:—						
Irish (Green)	108 0	104 0	106 6	103 0	105 0	103 0
Canadian (Green sides)	96 6	90 0	96 0	92 0	95 0	90 0
HAMS:—						
York (Dried or Smoked)	130 6	126 6	—	—	137 0	131 6
Irish (Dried or Smoked)	—	—	—	—	129 0	123 6
American (Green) (long cut)	81 0	77 0	83 6	79 6	84 0	80 6
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British...	20 0	—	—	—	21 5	19 9
Irish	18 7	18 1	17 4	16 5	18 7	17 10
Danish...	—	—	—	—	20 0	18 6
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
British Queen ...	91 0	77 6	—	—	93 6	85 0
Edward VII.	91 6	83 0	71 6	66 6	91 0	81 6
Up-to-date	86 6	76 0	66 6	63 6	88 6	79 0
HAY:—						
Clover	—	—	166 0	130 0	128 6	117 6
Meadow	—	—	—	—	120 6	110 6

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	WHEAT.						BARLEY.						OATS.					
	1913.		1914.		1915.		1913.		1914.		1915.		1913.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Jan. 2...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
,, 9...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
,, 16...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
,, 23...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
,, 30...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
,, 13...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
,, 20...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
,, 27...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
,, 13...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
,, 20...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
,, 27...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3...	31	4	31	6	54	6	27	0	25	6	31	9	19	2	18	5	30	6
,, 10...	31	3	31	5	54	9	27	8	26	8	31	3	19	2	18	4	30	4
,, 17...	31	6	31	7	55	4	26	11	25	4	30	10	18	10	18	4	30	5
,, 24...	31	8	31	9	56	5	26	7	26	6	31	5	19	3	18	5	30	11
May 1...	32	2	31	9	58	3	25	11	26	0	32	7	19	6	18	5	31	5
,, 8...	32	6	32	2	60	5	25	9	25	6	33	3	19	6	18	9	32	4
,, 15...	32	10	32	7	61	7	25	4	26	3	34	0	19	9	18	11	32	5
,, 22...	32	10	33	0	62	0	25	3	25	10	34	1	19	11	19	0	32	8
,, 29...	32	7	33	9	61	11	26	1	26	1	34	8	20	1	19	4	32	7
June 5...	32	10	34	0	61	9	26	2	25	11	35	4	19	8	19	4	32	5
,, 12...	32	8	34	1	60	1	24	7	24	11	34	5	20	2	19	8	32	4
,, 19...	32	8	34	1	56	1	23	10	25	10	34	3	19	8	19	9	31	9
,, 26...	32	8	34	3	52	0	24	3	25	4	34	4	19	1	20	0	31	9
July 3...	33	1	34	4	49	5	25	2	24	6	35	3	21	0	19	9	31	1
,, 10...	33	4	34	2	50	1	25	10	24	9	34	7	19	4	20	0	31	6
,, 17...	33	6	34	1	52	7	24	9	24	2	35	8	20	5	19	10	31	6
,, 24...	33	10	34	0	53	10	24	1	24	7	35	10	20	8	19	9	32	1
,, 31...	34	1	34	2	55	3	24	5	25	9	36	1	20	3	19	8	31	1
Aug. 7...	34	1	34	9	55	4	24	9	25	2	35	7	19	0	19	1	31	5
,, 14...	34	3	40	3	55	2	24	7	29	4	37	0	18	7	25	1	31	7
,, 21...	33	7	38	9	54	3	26	5	29	10	39	4	18	8	24	3	31	4
,, 28...	32	7	36	2	51	11	29	0	30	3	38	3	17	10	23	5	30	0
Sept. 4...	31	11	36	5	45	3	30	11	30	6	38	1	17	8	23	9	26	10
,, 11...	31	9	37	10	43	0	31	5	29	11	37	11	18	0	23	11	26	8
,, 18...	31	7	38	3	42	9	30	9	29	5	39	0	17	11	23	8	26	4
,, 25...	31	6	37	6	43	3	30	1	29	3	39	8	17	9	23	3	26	1
Oct. 2...	31	3	37	1	43	5	29	9	29	1	40	4	17	10	22	9	26	5
,, 9...	31	0	36	8	44	1	29	1	28	10	41	0	17	10	22	5	26	5
,, 16...	30	11	36	7	45	9	28	8	28	8	42	3	17	9	22	4	27	1
,, 23...	30	7	37	2	48	2	28	7	28	7	44	0	18	0	22	5	28	1
,, 30...	30	1	37	10	50	3	28	2	28	3	46	2	17	9	23	7	29	1
Nov. 6...	30	0	38	8	51	6	28	1	28	6	47	3	17	9	23	7	30	4
,, 13...	30	1	39	8			27	8	29	0			17	11	24	8		
,, 20...	30	4	41	0			27	5	29	8			18	1	25	5		
,, 27...	30	9	41	11			27	0	30	3			18	4	25	8		
Dec. 4...	31	2	42	2			26	8	30	2			18	4	25	9		
,, 11...	31	2	42	1			26	5	29	11			18	6	25	9		
,, 18...	31	2	42	7			25	11	29	8			18	5	25	9		
,, 25...	31	0	43	3			25	10	29	9			18	4	25	11		

NOTE. Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley, and Oats** at certain Markets during the Month of October, 1914 and 1915.

—	Wheat.		Barley.		Oats.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
London	38 10	48 2	29 8	45 5	24 4	29 8
Norwich	36 9	45 4	28 3	42 8	22 9	27 8
Peterborough	36 6	46 4	29 5	43 11	22 9	27 7
Lincoln	36 1	46 8	29 11	43 6	22 3	27 11
Doncaster	35 7	46 0	27 0	41 4	21 8	26 11
Salisbury	37 7	46 8	29 4	41 2	23 0	27 5

ADDITIONS TO THE LIBRARY.

Live Stock—

Aberystwyth, University College of Wales. Agricultural Department.—Gorse as Food for Farm Animals. (8 pp.) Aberystwyth, 1915. [63·604(*a*).]

Day, G. E.—Productive Swine Husbandry. (363 pp.) Philadelphia and London: J. B. Lippincott Company. $1.50 net. [63·64(04).]

Boucaut, Sir J. P.—The Arab Horse, the Thoroughbred and the Turf. (222 pp.) London: A. F. Bird, 1912. 5*s.* net. [63·61(02).]

Ireland, Department of Agriculture and Technical Instruction.—Minutes of Evidence, Appendices, and Index of the Departmental Committee on the Irish Pig-Breeding Industry. [Cd. 8004.] (139 pp.) London: Wyman & Sons, 1915. 1*s.* 2*d.* [63·6(415).]

Canada, Department of Agriculture. Live Stock Branch. Sheep and Goat Division.—Pamphlet 12:—The Angora Goat: Methods of Management, Feeding, Breeding, and Mohair Production. (22 pp.) Ottawa, 1915. [63·63.]

Missouri Agricultural Experiment Station.—Research Bull. 18:—The Maintenance Requirement of Cattle. (62 pp.) Columbia, Missouri, 1915. [612·394; 63·62.]

Jones, C. Bryner [edit.]—Live Stock of the Farm, Vol. I.:—Cattle. (254 pp.) London: Gresham Publishing Company, 1915. 42*s.* net the 6 vols. [63.6(03).] Utility Rabbit Keeping: with Chapters on Fancy Breeds and How to Exhibit Them. (126 pp.) London: C. A. Pearson, 1915. 1*s.* net. [63.69.]

Dairying and Food, General—

Thompson, W. H.—Food Values; with a Note on the Conservation of Irish Food Supplies. (39 pp.) Dublin, 1915. 3*d.* [612·39.]

Durham County Council, Education Department.—Offerton Bull. 5:—Report on Further Experiments on the Feeding of Dairy Cows. (40 pp.) Newcastle-on-Tyne, 1915. [63·711.]

U.S. Department of Agriculture.—Bull. 240:—Pasteurizing Milk in Bottles and Bottling Hot Milk Pasteurized in Bulk. (27 pp.) Washington, 1915. [63·717.]

Veterinary Science—

Moore, V. A.—Bovine Tuberculosis and its Control. (134 pp. + XXX. plates.) Ithaca, N.Y.: Carpenter & Co., 1913. $2.00 net. [614·5.]

Departmental Committee on Swine Fever.—Part IV.:—Final Report, Minutes of Evidence and Appendix. [Cd. 8045.] (63 pp.) London: Wyman & Sons, 1915. 8*d.* [619·4(*a*).]

U.S. Department of Agriculture.—Bull. 245:—Further Experiments in the Destruction of Fly Larvæ in Horse Manure. (22 pp.) Washington, 1915. [59·169(*c*).]

Montana Agricultural Experiment Station.—Bull. 105:—The Intradermal Test in Bovine Tuberculosis. (351-380 pp.) Bozeman, Montana, 1915. [614.5.]

Birds, Poultry, and Bees—

New South Wales Department of Agriculture.—Farmers' Bull. 103:—Egg-Laying Tests at Hawkesbury Agricultural College. 13th year's Results. (19 pp.) Sydney, 1915. [63·651(04).]

Morin, E.—La Plume des Oiseaux et l'Industrie Plumassière. (96 pp.) Paris: J. B. Baillière et Fils, 1914. [63·763.]

Maine Agricultural Experiment Station.—Bull. 228:—Factors influencing the Size, Shape, and Physical Constitution of the Egg of the Domestic Fowl. (105-136 pp.) [63·74.] Bull. 231:—Improving Egg Production by Breeding. (217-236 pp.) [63·651(04).] Bull. 232:—The Histological Basis of the Different Shank Colors in the Domestic Fowl. (237-252 pp.) [63·651(04).] [Included in Annual Report, 1914.]

Boelter, W. R.—The Rat Problem. (165 pp.) London: John Bale, Sons and Danielsson, Ltd., 1909. [63.269.]

Lewis, H. R.—Productive Poultry Husbandry. (536 pp.) Philadelphia and London: J. B. Lippincott Company, 1914. $2.00 net. [63.651(02).]

U.S. Department of Agriculture.—Farmers' Bull. 682:—A Simple Trap Nest for Poultry. (3 pp.) Washington, 1915. [63.6 : 69.]

Canada Department of Agriculture.—Bull. 16, Second Series:—How to Tell the Age of Hens and Pigeons. (19 pp.) Ottawa, 1913. [63.651(04); 63.656.]

Rhode Island Agricultural Experiment Station.—Bull. 159:—Studies on Fowl Cholera: IV. The Reciprocal Relations of Virulent and Avirulent Cultures in Active Immunization. (381-403 pp.) [619.5(*a*).] Bull. 161:—Studies on Inheritance in Poultry: II. The Factor for Black Pigmentation in the White Leghorn Breed. (447-459 pp.) [63.651(04).] Bull. 162:—Sex Ratios in Pigeons, together with Observations on the Laying, Incubation, and Hatching of the Eggs. (461-512 pp.) Kingston, R.I., 1915. [63.656.]

Forestry—

Schweizerisches Forstverein.—Die forstlichen Verhältnisse der Schweiz. (220 + 22 pp.) Zürich: Beer & Cie, 1914. [63·49(494).]

New South Wales, Department of Forestry.—Bull. 9:—Practical Forest Assessment and Survey. (16 pp.) Sydney, 1914. [63.49-19.]

California Agricultural Experiment Station.—Bull. 252:—The Deterioration of Lumber. (301-320 pp.) Berkeley, Cal., 1915. [63.49-198.]

Engineering—

Bartholomew, J. G.—An Atlas of Economic Geography. (LXIV pp. + 64 Maps.) London: Oxford University Press, 1914. 5*s.* net. [912; 38.]

Bashore, H. B.—Overcrowding and Defective Housing in Rural Districts. (92 pp.) New York: John Wiley & Sons. London: Chapman & Hall, 1915. 4*s.* 6*d.* net. [333.32; 614.]

Parsons, J. L.—Land Drainage: A Treatise on the Design and Construction of Open and Closed Drains. (165 pp.) Chicago: Myron C. Clark Publishing Company, London: E. & F. N. Spon, 1915. [63.14.]

Economics—

Carter, G. R.—Co-operation and the Great War. (20 pp.) London: P. S. King & Son. [1915]. 3*d.* [334(04).]

(4152.) Wt. P. 16—9. 7250. 11/15. J. T. & S., Ltd.

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 9.

DECEMBER, 1915.

REPORT ON THE WORK OF THE SPECIAL ENQUIRIES BRANCH FOR THE FIRST TWELVE MONTHS OF THE WAR.*

THE special work of the Board in connection with the war began on 1st August, 1914, with an enquiry as to the supplies of wheat then in the country. With the assistance of several members of the corn trade enquiries were made by telegraph, and a Press *communiqué* was prepared, and issued on 4th August. These enquiries were continued, and supplemented, and a Special Enquiries Branch was established charged with the duty of collecting all available information as to the food resources of the country, and the effect of the war on farming generally.

A staff was collected from the Statistical Branch, and from other branches of the office, while the outdoor staff of the Statistical Division was enlarged by enlisting the services of inspectors from the Commercial Control Branch and the Land Division, and by the engagement of temporary officers. At present eight inspectors are stationed in various districts, all of whom are primarily attached to the Special Enquiries Branch, but are partly employed on other duties.

The inspectors furnish reports weekly on the general conditions of agriculture in their districts, with special reference to any circumstances arising out of war conditions. They also make enquiries on particular subjects as directed, and individual complaints are personally investigated by them.

In the month of August, 1914, the main energies of the Branch were directed to the collection of information as to home-grown food supplies, and on the basis of this information

* NOTE.—The separate publication of reports on the work of the various Branches of the Board has been suspended for the present. Such reports will appear in condensed form in this *Journal* from time to time.

the Board and the Agricultural Consultative Committee were able to issue a number of Press notices. Returns of stocks of wheat and flour, meat and provisions, oilseeds, cake, and fertilisers were obtained, and memoranda prepared as to existing and prospective supplies, and prices of the principal agricultural commodities. After a very short period the enquiries as to food supplies, and similar questions, developed largely in the direction of ensuring that the maintenance of those supplies was secured by preventing the undue export of commodities which were required at home.

The Work of the Inspectors.—The complaints received from farmers and others in the early stages of the war were very numerous. They arose mainly from the somewhat marked rise in the price of commodities, such as feeding stuffs, which was considered by buyers to be unreasonable. The sellers were usually able to show that the difference between the price charged by them and the wholesale price in some neighbouring market was due to the addition of charges, which could not be regarded as unreasonable, in respect of carriage, delivery of small quantities, and long credit. There can be little doubt, however, that the enquiries of the inspectors exercised a moderating influence on prices, and the knowledge that enquiries might be made tended to prevent excessive charges in other cases.

A second class of complaint, which was common at one period of the year, arose from the assertion that farmers were unduly withholding wheat from market. No foundation was found for this statement, which appeared to arise mainly from temporary delays in threshing caused by unfavourable weather. Numerous complaints by farmers as to the action of the War Office in regard to the purchase of hay were investigated, and enquiries were also made in numerous instances as to cases of the slaughter of pregnant cows and sows, and of young calves. Reliable evidence as to the prevalence of this practice was thus collected.

A large number of cases relating to other subjects, such as labour and transport difficulties, etc., were investigated. Interviews with farmers and with representatives of agricultural associations have been very numerous, and these have afforded opportunities both for hearing farmers' views, and for advising them on many subjects.

The inspectors have been called upon at frequent intervals to make special enquiries as to the position in their districts as regards certain agricultural questions. For example,

the supply of labour, and the effect of recruiting; the slaughter of immature and breeding stock; the decrease in the consumption of meat; the condition of the poultry industry, and the effect of the war on small holders; the supply and prices of fertilisers, agricultural seeds, hay and straw, and fresh and condensed milk, have all been the subject of special enquiry, apart from the general observations on these subjects which are included in the weekly reports. In addition, the supply of steam ploughs, and threshing and other agricultural machinery, the prevalence of stack fires, the supply of baskets and hampers, and of glass jars for the jam and fruit preserving industry, have been enquired into with useful results.

The inspectors were also asked to draw attention to exceptional circumstances in regard to agricultural conditions to which it seemed desirable to direct the notice of the Board. In this respect there can be little doubt that their reports have been of great value in keeping the Board promptly and systematically informed as regards the prevailing agricultural opinion on subjects to which attention has been directed at one time or another during the year. The inspectors of the Special Enquiries Branch have, by constant personal contact with farmers, been able to report views which would otherwise not have reached the Board.

Collection of Information as to Supplies of Agricultural Commodities.—In addition to enquiries already mentioned as having been made into the supplies of wheat at the outbreak of war, enquiries were made by the inspectors, and information was obtained from other sources as to the supply of other agricultural foodstuffs, and a general review of the position was prepared for the information of the Board on 9th August, showing the normal consumption, imports, existing stocks, and prospective supplies of grain, corn offals, meat, provisions, oilcake, fertilisers, etc.

The enquiries thus instituted were repeated on 1st September in a more systematic manner, and have since been continued monthly.

In continuation of the general review of the position as regards the supply of agricultural foodstuffs, referred to above, a detailed examination of the trade in all agricultural commodities has been made and incorporated in memoranda and reports, which are revised and brought up to date at frequent intervals. They were intended not only to show the position of this country in the event of any serious interference occurring in our import trade, but also to supply materials

for arriving at decisions in regard to the export of numerous articles, the export of which was only allowed by licence.

Control of Supplies through the Prohibition of Exports.—On the outbreak of war, Proclamations were issued prohibiting the exportation from the United Kingdom of "forage and food of all kinds for animals," and "provisions and victual of all sorts which may be used as food for men."

These Proclamations were subsequently amended and revised in many ways, and at the present time the export is prohibited of all feeding stuffs, cereals, and fertilisers, together with certain other articles, such as clover and grass seed, binder twine, malt, etc.

Notwithstanding the formal prohibition of the export of the specified commodities from this country, export may be allowed under licence. The issue of licences is controlled by the War Trade Department, who are advised by the Board of Agriculture as regards agricultural commodities.

The extent of the work in which the Board are concerned may be gathered from the fact that over 11,000 applications for export licences were dealt with between 1st September, 1914, and 31st August, 1915, and the monthly number of applications rose from 143 in September, 1914, to 1,741 in August, 1915. The number of separate articles on which recommendations have to be made on behalf of the Board was 93 at the end of September, 1915.

The two objects which are kept in view in advising the War Trade Department as to the action to be taken on the applications submitted, are (1) the conservation of our home supplies, and (2) the prevention of goods reaching the enemy. In regard to the first object, the position of our home stocks, prices, and prospective imports are studied by the staff of the Special Enquiries Branch, and the export is carefully controlled on the basis of the comprehensive information which is collected for this purpose.

The prevention of goods reaching the enemy is primarily the function of the War Trade Department, but, in practice, the consideration of this question is, to a large extent, combined with the question of supplies.

On the one hand it has been very desirable, on national grounds, to avoid undue interference with any legitimate export trade, while, on the other, it has been necessary to ensure that the export was approved of only such commodities as could be spared from this country without injury to the home consumer. In order to maintain, and, if possible,

develop trade, exporters made urgent representations in support of their applications, and in many cases were encouraged thereto by the fact that prices abroad were appreciably higher than in this country. These applications were very frequently supported by the Governments of our Allies, or of neutral countries, and had to receive special consideration.

It was also necessary to consider the maintenance of the supply of food imported into this country. Certain neutral countries have established a regular trade in the supply to the United Kingdom of a large proportion of its requirements of butter, bacon, eggs, margarine, and condensed milk, and the continuance of this trade was obviously desirable. It became evident on the outbreak of war that, in order to maintain these supplies of food, the countries concerned required to obtain feeding stuffs, for the supply of which they had hitherto been dependent partly on this country, and partly on other sources which had been cut off. Mutual arrangements were accordingly made as far as possible so as to maintain normal conditions. In all such arrangements special care was taken to ensure that any exports allowed from this country should be restricted to those which could best be spared, having regard to the full information in the possession of the Board as to the present and prospective stocks of each article.

The requirements of other neutral countries, as well as of our Allies and of British Possessions, have also had to receive special consideration.

This new class of work naturally gave rise to questions of much complexity in regard to which no guidance from past experience was available. It may be of interest to draw attention here to a few of the difficulties which have been met with—difficulties which in most cases were made more acute by the fact that the would-be exporter expected a decision to be reached immediately his application was made.

From the point of view of supplies, it quickly became apparent in the case of articles which are mainly imported that the mere prohibition of export would not necessarily increase the supplies in the country. If, owing to a momentary lack of demand at home or high prices abroad, importers were disinclined to buy, the stocks in this country of any particular article might run down to a very low figure although absolutely no export had taken place. It became, therefore, a question whether the importer would not buy more freely, and thus maintain supplies at a higher level, if he were allowed to continue an export trade.

There were, in fact, only a limited number of articles in which absolute prohibition clearly tended to increase the supply in the country. These were, mainly, by-products produced in course of manufacture of other goods. Milling offals are an example. They are produced in the manufacture of flour, and although inability to dispose of them except at a very low price would raise the price of flour it would not in itself reduce the quantity manufactured. There were at first very plentiful supplies of wheat in the country, and milling was very active, so that for a time it was possible to allow a limited quantity of milling offals to be exported without detriment to any national interest. As soon as it became apparent that the home demand was sufficient to prevent the mills from becoming congested, and their stocks from deteriorating, the issue of further licences was stopped, and no export of milling offals was sanctioned by the Board after October, 1914. By the policy adopted the total supply of milling offals in the country was increased by about 200,000 tons over that available for home consumption in the previous year.

One difficulty connected with the licensing of exports arises from the fact that in many cases the effect of restricting the re-export of imported goods is to take the trade out of the hands of British merchants, and to cause foreign buyers to import direct from the country of origin. The result of this is two-fold. In the first place, the trade is placed in the hands of foreigners, and the probability of supplies reaching the enemy is thereby much increased. In the second place, the quantity of goods coming to this country at any particular time tends to decrease, with the result that the total quantity available is diminished.

Reference may be made also to the fact that trade interests were in some cases conflicting. Instances arose in which one group of traders very urgently desired to export while another group represented that any such export would be prejudicial to the interests of the home consumer.

The prohibitions have on the whole been effective as a means of conserving our supplies of agricultural commodities. They have probably had comparatively little effect on the general level of prices, which have been governed by other causes, but they have undoubtedly prevented the undue depletion of our stocks. In the absence of the control afforded by the prohibitions the much higher prices which could be obtained abroad would frequently have resulted in such a drain on our home stocks as to cause a shortage and consequently great in-

convenience, and no doubt in some cases considerable fluctuations in price. In certain cases the prohibitions have undoubtedly been effective in moderating the rise of price in essential commodities, and especially in foodstuffs.

Meat Supplies.—The work of the Special Enquiries Branch under this head has been directed towards ascertaining (1) the probable requirements of the United Kingdom; (2) the prospects of supplies (*a*) from abroad, and (*b*) from the slaughter of home stock; (3) the measures necessary to ensure that the demand for meat should not lead to such a drain on the live stock of the United Kingdom as might endanger future supplies.

Normally, about 40 per cent. of the supplies of beef and mutton (including veal and lamb) required by the United Kingdom comes from abroad. After the outbreak of war, supplies from overseas were affected by the requirements of the British and French Armies. The supplies thus diverted could not be readily replaced by increased imports owing to (1) the lack of vessels, and particularly of vessels fitted for the carrying of refrigerated meat, and (2) the lack of facilities for refrigerating meat in countries from which little or no meat had previously been imported. The reduction of imported supplies could not be made up from home stock, except by slaughter to a degree likely to endanger future supplies, and such slaughter was only probable (other circumstances being normal) under the influence of high prices. There was no material rise in prices, however, before the end of the year, but in the meantime the increased cost of feeding stuffs led to excessive slaughter of some classes of animals, more especially pigs. Later, the general rise in the prices of feeding stuffs, together with the shortage of labour due to recruiting, tended to lead to increased marketing of live stock, more particularly on the part of dairy farmers. From the beginning of this year prices of meat, and consequently of live stock, rose rapidly, and reports began to reach the Board that the slaughtering not only of young animals, but also of female breeding stock, was being carried out to a dangerous extent.

In considering the prospects of supplies of meat, it was thus not sufficient merely to ascertain the quantities likely to be imported from abroad, and the surplus after meeting the requirements of the British and French Armies, and to estimate the probable supply from home stocks. Account had also to be taken of the effect on the slaughter of home stock of the various factors already indicated, viz., the shortage of imported supplies, the high prices offered for live stock,

the increased cost of feeding stuffs, and the shortage of labour, and, on the other hand, any change in the consumption of meat arising from high prices, from motives of economy, from a reduced civil population owing to enlistment, from increased wages, and so on.

The position was closely watched, and reports were obtained from time to time not only from the Inspectors of the Branch, but also from the Board's Market Reporters. The information thus furnished was supplemented by returns of animals slaughtered, obtained from local authorities owning public slaughterhouses, and the Board decided that a case for their intervention was established. After conference with the Scottish and Irish Departments and reference to the Agricultural Consultative Committee, an Order under the Slaughter of Animals Act, 1914, was passed prohibiting the slaughter of in-calf cows, in-pig sows, and of calves (with certain exceptions) under the age of twelve weeks. This Order came into force on the 24th June. Experience showed that it was necessary to obtain statutory powers beyond those conferred on the Board by the Slaughter of Animals Act, and the Maintenance of Live Stock Act, 1915, was in consequence passed. Under the latter Act, a new Order—the Maintenance of Live Stock Order of 1915—was passed by the Board, and came into force on the 23rd August. This superseded the previous Order, and met certain difficulties and hardships which the latter had occasioned. The administration of these Orders was entrusted to the Live Stock Branch.

The shortage in the meat supplies available for the civil population led to a consideration of the question of encouraging further imports from abroad. The foreign animals wharves, which were formerly used for the reception of such animals, could not be made readily available, as the trade in foreign cattle had practically ceased for some considerable time before the outbreak of war, but it was decided to re-open some of them, and in August Orders under the Diseases of Animals Act were passed, which permitted the landing, for slaughter, of animals from certain countries at Avonmouth and Cardiff, and from Canada at Birkenhead. No animals were in fact landed during the year.

A matter arising out of the work of the Branch on the subject of meat supplies has been the calling of the attention of agriculturists generally, by means of posters and circulars, and in other ways, to the desirability of maintaining, and, if possible, increasing the numbers of live stock in the country.

COST OF WINTER FEEDING IN MILK PRODUCTION.

G. H. GARRAD, N.D.A.,

Agricultural Organiser for Kent.

THE cost of production of milk on the farm is a matter of the greatest importance to a milk producer. It involves many factors, such as the labour in attendance and milking, depreciation in the value of the cow, illness and calving risks, interest on capital, cost of litter, etc., and all these have to be considered before it is possible to say what it actually costs the farmer to produce his milk, but the principal item of expenditure is undoubtedly the cost of the food.

An investigation was begun by Wye College in 1908 with the purpose of arriving at some reliable estimate of the cost of feeding dairy cows in the South-Eastern district of England. During the winters of 1908-9-10 a milk recorder paid single visits to a large number of farms in Kent and Surrey, and weighed the food fed to the cows, and the milk yielded on the morning and evening of his visit, but in the winter of 1911-12 a change was made in the system adopted, and during the past three seasons the recorder has paid a series of monthly visits, summer and winter, to a smaller number of farms because it was thought that the data so obtained would be more accurate.

All the farmers concerned were asked at the beginning to estimate the cost per ton of growing their different home-grown foods, but these estimates varied so widely on the individual farms that it was found desirable to take the average costs per ton, and to use these as a basis on every farm, and in every season. After arriving at the averages, therefore, from the estimates given, the following prices per ton were fixed upon, and used in all the subsequent calculations :—

	s.	*d.*	
Mangolds, Swedes and Cabbages	10	0	per ton.
White Turnips	8	0	,,
Chat Potatoes	20	0	,,
Meadow Hay	60	0	,,
Oat, Pea and Bean Straw	40	0	,,
Barley and Wheat Straw	25	0	,,

The labour in the preparation of the foods is not included, and must be charged to the labour account. The figures

may be criticised as being too high or too low, but they are the mean of the estimates supplied, which varied between the following limits: hay, 50*s.* to 70*s.*; mangolds, 6*s.* 8*d.* to 15*s.*; oat straw, 35*s.* to 60*s.* At the present time, with an increase in the cost of labour and manures, it may quite reasonably be argued that the costs agreed upon before the outbreak of war are now too low. Home-produced meals were taken at the estimates given, and purchased cakes and meals at the price actually paid for them with a small allowance for cartage.

In making the calculations for the individual farms, only the foods fed to the cows actually in milk were included. The foods fed to dry and fattening cows were not taken into account. It was considered that the value or the sale price of a fat cow and of the calf would, on the whole, give a return balancing the cost of the food used when the cows were dry.

The winter period covered by these figures has been taken to be from 1st November to 30th April (26 weeks). A summary of the results for the past three winters is shown in the following table:—

TABLE I.—*Summary of the Results for Three Winters.*

No. of Herds.	No. of Cows in Milk.	Daily Yield per Cow.	Cost of Food per Cow per day.	Cost of Food per gal. of Milk.	Average Daily Rations. Roots.	Hay.	Straw.	Wet Grains.	Cakes and Meals.
		Gal.	Pence.	Pence.	lb.	lb.	lb.	lb.	lb.
20 (1914–15) ..	619	2·13	12·18	**5·72**	39	9·0	6·5	1·4	7·7
18 (1913–14) ..	632	2·25	12·15	**5·40**	52	9·4	3·9	4·7	7·2
11 (1912–13) ..	415	2·12	12·22	**5·76**	56	6·5	5·2	4·5	7·5
Average ..	1,666	2·17	12·22	**5·63**	49	8·3	5·2	3·5	7·5

It will be seen that the average daily yield of milk per cow was 2·17 gal. (which can be translated into yield during the milking period—42 weeks—by multiplying by 294), the daily cost of food 12·22*d.*, and the cost of food per gal. of milk 5·63*d.* The cost of feeding in the winter of 1914-15 was slightly higher than in the previous winter on account of the increased prices of purchased foods, but most of the farmers had made their winter purchases before prices had seriously advanced, so that the effect is much less than might have been expected. Every year there was very great variation in the cost of feeding on the different farms, as is shown by the following figures:—

TABLE II.—*Farms Classified According to the Cost of Feeding.*

Cost of Feeding.	Number of Farms. 1914–15.	1913–14.	1912–13.
Less than 5*d.* per gal.	5	8	1
From 5*d.* to 6*d.* per gal.	7	6	7
„ 6*d.* „ 7*d.* „ „	6	3	2
„ 7*d.* „ 8*d.* „ „	1	1	1
„ 8*d.* „ 9*d.* „ „	1	0	0

In the winter of 1912-13 the two extremes were 4·30*d.* and 7·46*d.* per gal. of milk; in 1913-14 4·21*d.* and 7·08*d.* per gal.; and in 1914-15 4·64*d.* and 8·18*d.* per gal. In every year the feeding was costing nearly twice as much per gal. of milk on some farms as on others; and yet on every farm roots, hay, and straw were valued at the same prices, and each farmer had the same opportunity of buying the same concentrated foods at practically the same prices in the open market. Under these conditions it would seem that if some farmers can produce milk at between 5*d.* and 6*d.* per gal. for food, others ought to be able to do the same, provided cost prices are normal.

By dividing all the herds up into three sets—Set I., those herds giving the cheapest milk; Set III., those herds giving the most expensive milk; and Set II., those intermediate—it is possible to eliminate the individuality of the different herds, and to obtain some information as to the reason why the

TABLE III.—*Comparison of Costs. Winters* 1912-13-14-15.

—	Daily Yield per Cow.	Cost of Food per Cow per Day.	Cost of Food per gal of Milk.	Average Daily Ration. Roots.	Hay.	Straw.	Wet Grains.	Cakes and Meals.
	Gal.	Pence.	Pence.	lb.	lb.	lb.	lb.	lb.
11 Farms, Winter 1912-13								
4 Cheap Herds	2·08	10·50	**5·05**	36	5·5	4·5	2·0	7·6
4 Intermediate	2·15	12·36	**5·75**	62	6·2	4·6	6·6	6·6
3 Expensive Herds ..	2·16	14·58	**6·75**	77	8·2	6·9	5·0	7·9
18 Farms, Winter 1913-14								
6 Cheap Herds	2·35	10·98	**4·67**	54	7·7	4·9	3·3	6·7
6 Intermediate	2·22	11·51	**5·18**	51	10·3	4·0	2·4	6·3
6 Expensive Herds ..	2·21	13·77	**6·19**	52	10·3	2·6	8·3	8·5
20 Farms, Winter 1914-15								
7 Cheap Herds	2·48	12·17	**4·91**	38	8·6	4·2	3·0	8·3
7 Intermediate	2·21	12·79	**5·79**	46	8·2	6·3	Nil	8·5
6 Expensive Herds ..	1·66	11·57	**6·97**	30	10·3	9·1	1·0	6·0
Average of all the above—								
17 Cheap Herds ..	**2·30**	**11·22**	**4·88**	**43**	**7·3**	**4·5**	**2·8**	**7·5**
17 Intermediate ..	**2·19**	**12·22**	**5·57**	**58**	**8·2**	**5·0**	**3·0**	**7·1**
15 Expensive Herds ..	**2·01**	**13·81**	**6·83**	**53**	**9·6**	**6·2**	**4·9**	**7·5**

cost per gal. is so much higher on some farms than on others. This is done in the table at the bottom of the previous page.

A heavy milk yield associated with a low cost of feeding is evidently the end to be aimed at in economical milk production. The figures of every winter have demonstrated this, and especially the figures of 1914-15, for last winter the seven cheapest herds averaged fully ¼ gal. of milk per head per day more than the seven intermediate herds, and the intermediate herds fully ½ gal. of milk per head per day more than the six expensive herds.

It does not necessarily follow, however, that a heavy milking herd is a cheap milk-producing herd. The heaviest milking herd in 1914-15 only ranked sixth in the list from the standpoint of economy, and the most economical milk-producing herd averaged less milk per head per day than eight other herds. Milk yield, therefore, must be considered in relation to the cost of feeding. One has to distinguish between naturally heavy-milking cows, and cows that only yield well because they are liberally fed. Cows which milk heavily on a normal ration, and without heavy feeding, are the cows that pay best. Such cows can be obtained by breeding and occasionally by purchase, and it is a far sounder investment to pay a little extra for such cows, or to get a bull that will help to breed such cows, than to buy an ordinary class of cow and try to promote a good flow of milk by heavy feeding. High feeding will only to a very limited extent increase the flow of milk, and will always be an expensive proceeding.

One of the main reasons why some farmers have been so extravagant in feeding their cows has been that they have not fed according to the milk yield. If cows are all fed alike it naturally follows that the low-yielding cows will be overfed and food wasted, while the heavy-yielding cows will be underfed, and will be likely to fall off both in yield of milk and in general condition. The heavier the yield of milk the better should be the feeding, and *vice versâ*. Every cow may have the same allowance of roots and fodder (the maintenance ration),* but the quantity of cake fed (the production ration)* should be strictly regulated according to the number of gallons of milk the cow is giving. The exact quantity needed will vary according to the mixture that is being fed, but as a rule from 3 lb. to 4 lb. per gal.

* Third Report on the Cost of Food in the Production of Milk in the Counties of Kent and Surrey, 1914, by G. H. Garrad. Issued by the South-Eastern Agricultural College, Wye.

of milk will be required. Thus, cows giving 1 gal. of milk a day should receive 3 lb. to 4 lb. cake and corn ; 2-gal. cows, 6 lb. to 8 lb. cake and corn ; 3-gal. cows, 9 lb. to 12 lb. cake and corn, and so on. A really heavy-milking cow is drawing very seriously on her constitution when her milk yield is at its height, as she is frequently unable to eat a sufficient quantity of food to supply all her needs, and consequently she loses condition. The proper course in such cases is to get cows that are known to be heavy milkers into as good condition as is safe before they calve, and then to feed them as liberally as possible during the period that they are in full milk.

The daily amount of milk each cow is giving should be chalked up periodically over her head. and the quantity of cake and meal should be measured out to each cow according to the figure thus recorded. This entails very little extra trouble and is a reasonable, scientific, and economical system of feeding.

At the commencement of this enquiry,† during the winters of 1908-9-10, the recorder paid only a single visit to a large number of farms in Kent and Surrey, and weighed the food fed to the cows on the day of his visit, and the milk yielded. These herds can be classified as follows :—

TABLE IV.—*Comparison of Costs. Winters* 1908-9-10.

—	Daily Yield per Cow.	Cost of Food per Cow per day.	Cost of Food per gal. of Milk.	Average Daily Ration.				
				Roots.	Hay.	Straw.	Wet Grains.	Cakes and Meals.
	Gal.	Pence.	Pence.	lb.	lb.	lb.	lb.	lb.
17 Cheap Herds	2·38	13·66	**5·74**	81	8·5	6·5	17·7	4·8
17 Intermediate	2·14	15·43	**7·21**	83	11·9	6·6	11·6	6·6
17 Expensive Herds ..	2·08	18·49	**8·89**	91	17·7	5·8	16·8	6·2
Average (51 Herds) ..	2·20	15·86	**7·28**	85	12·7	6·3	15·4	5·9

The figures bear out the conclusion already drawn from the farms visited regularly month by month during the past three years, that the most profitable herds are those that give the most milk on the cheapest ration. Of the seventeen expensive herds no less than six were being fed on more than 100 lb. roots per head per day, and seven more than 20 lb. hay. It was in these home-grown foods, roots and hay, that extravagance was particularly noticeable in the first stage of the

† First Report on the Cost of Food in the Production of Milk, 1910, by J. Mackintosh. Issued by the South-Eastern Agricultural College, Wye.

enquiry, but farmers in the scheme were quick in correcting these faults once they were pointed out to them. For this reason especially the cost of feeding during the past three winters has been considerably less than during the preliminary stages. Roots at 10s. per ton are equivalent to 20 lb. per 1*d.*, so that 100 lb. of roots alone cost 5*d.* per day, and contain 8¾ gal. of water. One farmer was feeding 154 lb. mangolds per cow per day, and another 113 lb. roots and 43 lb. wet grains. In each of these rations about 14 gal. of cold water was being fed and the temperature of this water has to be raised to the temperature of the cow's body before she can make any use of her food. From an economical point of view it certainly seems undesirable to feed more than 60 lb. to 70 lb. roots per cow per day.

In the case of hay also, long hay was being fed practically without regard to quantity until it was pointed out that every lb. of hay wasted and trodden underfoot in the farmyard represented a loss of nearly ½*d.* to the farmer. On 22 farms (519 cows) an average of 20·3 lb. of hay per cow per day was being fed, and the cost of the milk averaged 7·77*d.* per gal. On another 30 farms (1,324 cows) an average of 7·8 lb. of hay was being fed, and the cost of the milk averaged 6·16*d.* per gal. There is every indication that the cost of milk production can be reduced by limiting the quantity of hay, and especially long hay, and replacing a proportion of it with oat straw. It is usually stated that a cow requires 20 lb. of fodder per day, but the average quantity fed on the farms embraced in the Wye College enquiry has been considerably less, about 13 lb. per day.

A summary of the winter feeding on all the farms during the past three winters is shown in the following table :—

TABLE V.—*Winter Requirements of an Average Cow (180 Days).*

—	1912–13.		1913–14.		1914–15.	
	Quantity.	Cost per ton.	Quantity.	Cost per ton.	Quantity.	Cost per ton.
		s. d.		s. d.		s. d.
Root Crops—tons ..	4·75	10 1	4·28	10 4	3·32	10 0
Fodder Crops—cwt. ..	18·54	49 0	21·16	53 0	23·14	51 0
Wet Grains—cwt. ..	7·42	19 3	8·48	17 10	2·29	21 6
Cakes and Meals—cwt. ..	12·01	136 0	11·34	129 0	12·48	136 6
Daily cost per Cow ..	**12·22*d.***		**12·15*d.***		**12·18*d.***	
Daily yield per Cow ..	**2·12 gal.**		**2·25 gal.**		**2·13 gal.**	
Cost of Food per gal. Milk	**5·76*d.***		**5·40*d.***		**5·72*d.***	

If an average of the three years is taken it will be found that the normal allowance of a cow for the six winter months (1st November to 30th April) and the cost of feeding are as follows :—

Daily.		£	s.	d.	
51 lb. ..	4·12 tons Roots at 10*s.* 2*d.* per ton	2	1	11	(23 per cent.).
13 ,, ..	20·93 cwt. Fodder Crops at 51*s.* per ton ..	2	13	5	(30 ,,).
3½ ,, ..	6·06 cwt. Wet Grains at 19*s.* 6*d.* per ton ..		5	11	(3 ,,).
7½ ,, ..	11·94 cwt. Cakes and Meals at 133*s.* 10*d.* per ton	4	1	2	(44 ,,).
	Total Cost of Food per Cow ..	£9	2	5	

Av. Daily Cost per Cow (£9 2*s.* 5*d* ÷ 180) .. 12·16*d.*
,, ,, Yield per Cow .. .. .. 2·17 gal.
,, Cost of Food per gal. of Milk .. .. 5·60*d.*

Mackintosh, in his Reading Investigation* found that the average cost of food on 12 farms from December, 1912, to April, 1913, was 5·97*d.* per gal. (13·06*d.* per day), valuing his home-grown foods at the same prices as those taken at Wye, but that when the home-grown foods were valued at the actual cost of production on the individual farms this figure was revised to 5·83*d.* per gal., the daily cost of the ration being 12·75*d.* per head instead of 13·06*d.* The daily yield of milk was 2·18 gal. The Wye figures for the same period, using "average" costs of home-grown foods, were:—daily cost of food 13·11*d.*, daily yield of milk 2·19 gal., and cost of food per gal. 5·99*d.* The farms in the Wye scheme, therefore, produced their milk at practically the same cost per gallon as the farms in the Reading scheme. The Nottingham Milk Record Society,† run under a scheme formulated by the Midland Agricultural and Dairy College, found that for the winter of 1913-14 the average daily cost of feeding was 1*s.* 6*d.*, and the cost of food per gal. 6¾*d.* In this case mangolds were valued at 12*s.* 6*d.* per ton instead of 10*s.*, and oat straw at 35*s.* per ton instead of 40*s.* The Wye figures for the same winter (26 weeks) using similar values for mangolds and oat straw were:—daily cost of feeding 1*s.* 1*d.*, and cost

* Bulletin XIX., University College, Reading: Milk Records, and Cost of Feeding Cows in Berkshire, 1913, by Jas. Mackintosh.

† Report on the Work of the Nottingham and District Milk Record Society for the year ended 31st October, 1914, by P. W. Bailey. Midland Agricultural and Dairy College.

of food per gal., 5¾*d*. The length of the winter period adopted by the Nottingham Society is not stated in their report.

The question now arises—exactly how much effect has a difference in the cost of roots, fodder, concentrated foods, etc., on the cost per gal. of the milk? It has been shown that the cost of feeding a cow averaging 2·17 gal. of milk a day throughout the six winter months is roughly £9, or 1*s*. per day, and that the concentrated foods and wet grains together are responsible for 47 per cent. of the total cost. The roots and the fodder crops are responsible for the remainder of the cost, and, as much larger quantities of these are fed in comparison with the cakes and meals, it follows that an increase of a few shillings per ton in the cost of producing mangolds or hay is far more serious than the same increase in the price of concentrated foods. Four tons of roots and 21 cwt. of hay and straw are consumed for every 12 cwt. of cakes and meals, a proportion of 7 lb. of roots, and 1¾ lb. of fodder per 1 lb. of cakes and meals. An increase or decrease of 1*s*. a ton in the cost of production of the root crop, or 4*s*. per ton in the cost of the fodder crop is, therefore, equivalent to an increase of 7*s*. per ton in the cost of concentrated foods. A rise of as much as 7*s*. a ton all round in the price of purchased foods will always be looked upon as a serious matter, as, indeed, it is, but it is not realised that this corresponds to a rise of only 1*s*. per ton in the cost of production of the root crop, or 4*s*. per ton in the cost of production of the hay and straw crop. A 15-ton crop of mangolds in a bad season costs almost as much to grow as a 25-ton crop in a good season, and, if the cost is estimated in each case at from £8 to £10 per acre, this means a difference of about 5*s*. per ton in the cost of production. This is equivalent to a rise of 35*s*. per ton in the cost of concentrated foods, and may happen in any unfavourable season. Similarly, the yield of hay from a meadow may easily vary from 17 cwt. to 27 cwt. per acre in different seasons, and this will make a difference of about 30*s*. per ton in the cost of production of hay. A cow consumes 1¾ times as much fodder as she does concentrated foods, so that this increase of 30*s*. per ton in the cost of either home-made or purchased hay is equivalent to a rise of about 52*s*. 6*d*. per ton in the price of cakes and meals. Some of the fodder consumed by the cow would, of course, be straw, but the same remarks apply, as a short crop of hay usually implies a short crop of straw, and a short

crop of straw increases the cost of production in exactly the same way.

The effect of a dry summer is, therefore, not merely felt immediately in increasing the cost of production of summer milk by drying up the pastures and entailing more expense on artificial foods, but it has a very considerable influence on the cost of winter milk as well. With the figures already given it is evident that half a crop of roots will increase the cost of winter milk by about £2 per head (2·67*d.* per day, or 1·23*d.* per gal.), and half a crop of fodder by about another £2 10*s.* per head (3·33*d.* per day, or 1·53*d.* per gal.), so that a dry summer, resulting in only half a crop of hay and straw, will mean an increase of 2¾*d.* per gal. (50 per cent.) in the cost of winter milk, without taking into consideration the concentrated foods at all. A cow only consumes about 12 cwt. of cakes and meals during the 26 weeks, so that. even if all concentrated foods rose 50 per cent. in price, this would not make a difference of more than £2 per head (2·67*d.* per day, or 1·23*d.* per gal.) in the cost of feeding. The chief difficulties at the present time are the price of cows, the difficulty of getting milkers, and the increased cost of labour with the consequent increased cost of home-grown foods.

In conclusion, it may be repeated that a low cost of food per gal. of milk depends on a heavy milk yield and a low cost of daily feeding. The low cost of feeding can be obtained by feeding a well-balanced ration in the right quantity* according to the milk yield of the cow, and composed of the cheapest foods* relative to their composition that the farmer is able to procure. A saving of ½*d.* per gal. in the cost of feeding works out, in the case of a single 600-gal. cow, to a reduction of £1 5*s.* in the food bill for the year, or, in the case of a herd of 30 cows, to a saving of £37 10*s.* per annum. A saving of ½*d.* per gal. in the cost of production is equivalent to obtaining an extra ½*d.* per gal. for the milk. Experience shows that in many cases a reduction of considerably more than ½*d.* per gallon can be effected, so that the slight increase in labour involved by the regular weighing or measuring of the food and the milk is very handsomely repaid by the results.

A heavy milk yield can only be obtained by careful breeding. Weekly milk records should be kept, and the figures added up

* Fourth and Final Report on the Cost of Food in the Production of Milk, 1915, by G. H. Garrad. Issued by the South-Eastern Agricultural College, Wye.

from week to week until the year is complete. The information so obtained should then be acted on. All the worst milkers should be eliminated and fattened off, and the best cows put to a bull of a good type, with a good milking ancestry, and the heifer calves reared. In that way the milk records of the whole herd will be gradually improved from year to year, and it can be easily proved that the more milk a cow gives the cheaper in proportion becomes her feeding. In most herds there are some cows that are not even paying for their keep, and the sooner these are discovered, and weeded out, the better. A 700-gal. cow will only cost, if fed scientifically, about 25s. more to feed than a 600-gal. cow, and, in return for the increased outlay, the owner gets an additional 100 gal. of milk, which, at an all-round price of 8*d.* per gal., would be worth £3 6s. 8*d.* She thus brings in £2 1s. 8*d.* more, net revenue, during the year than the 600-gal. cow, and an 800-gal. cow will bring in £4 3s. 4*d.* more, net return, than a 600-gal. cow.

The annual milk record of the cows that have been in the Wye Scheme during the past three years has averaged 656 gal. This figure is high, and is due to the fact that most of the farmers who take a hand in such an investigation as has been described are progressive farmers. 22 per cent. of the cows gave more than 800 gal., and there were 15 entire herds that averaged between 700 gal. and 800 gal. per head. These herds, when fed economically, are the ones that pay best, and form the standard at which every dairy farmer should aim. Full reports giving the details of the Wye College Milk Investigation have been published, and can be obtained at cost price by applying to the Secretary of the College.

NOTE.—It should be pointed out that no allowance has been made in this article for the manurial values of the feeding stuffs used in the investigation. This omission has been made intentionally, because the different systems of management of the dung and liquid manure on the various farms have made it impossible to use any recognised system of valuing the manurial residues, such as Hall and Voelcker's table for " cattle fattening in boxes or yards where there is no avoidable loss by drainage, and where the manure is not washed by rain." It should also be noted that the valuation of the cows at the beginning and end of the period was not taken into consideration.

THE USE OF PRESSED APPLE POMACE.

B. T. P. BARKER, M.A., and C. T. GIMINGHAM, F.I.C.
University of Bristol : Agricultural and Horticultural Research Station.

UNDER existing conditions it is of national importance that the maximum use should be made of all agricultural produce. While it is probable that good value is already being obtained from ordinary crops and stock, more attention, perhaps, could be profitably given to the by-products of the farm. Some of these may be only of purely local interest on account of their restricted occurrence ; but others of more general distribution deserve special consideration. The subject of this article, cider apple pomace, although it does not occur in all parts of the country, is produced in a fairly wide area. It is a product of most farms in Devon, Somerset, Gloucester and Hereford, and to a less degree in Monmouth and Worcester, and also in some districts of the counties adjacent to these. Outside the West of England it is produced in appreciable quantities in parts of Norfolk and Kent, and in small quantities in a few other counties. It is found, in addition, in some localities in Ireland.

Meaning of the term "Pomace."—The term pomace (in some districts it is called "must" or "mark") is used in the cider-making industry to denote the apple pulp in the form in which it is obtained after the fruit has been passed through the cider mill. Sometimes it is further limited to the pulp in the condition in which it comes from the cider press after the juice has been extracted. The material to which attention is here primarily given is the pulp in the latter state. Although the name pomace is used more particularly with reference to the pulp of cider apples it is also applied to the corresponding state of perry pears, and in this article the term is applied without distinction to the product of both apples and pears.

Quantity of Apple and Pear Pomace Produced.—The total quantity of apple and pear pomace produced annually in this country is considerable, and is certainly large enough to make the study of methods for its use worth while. No reliable direct statistics as to the amount are available, but it is possible to gain a rough idea by indirect calculation from the estimated annual production of cider and perry. According to the Report by the Board of Agriculture and Fisheries on the *Agricultural Output of Great Britain*, the estimated total production of cider and perry in 1908 in this country was approximately 22,133,000 gal. Reckoning at the rate

of 125–150 gal. of *mature* cider from 1 ton of fruit,* a standard which experience has shown to be fairly representative of the capacity of the various types of cider presses used in this country, this figure is equivalent to an approximate crop of 147,500–177,000 tons of cider apples and perry pears, and a yield of 44,250–53,100 tons of pressed pomace. The weight of pressed pomace from a ton of fruit varies somewhat. It is here taken as 30 per cent., a fair average figure.

There are various reasons for regarding this estimate as a low one. The year's output, if intended to refer to the cider and perry made during the winter 1907–8, was much below the normal owing to the poor crop of fruit. The late Mr. C. W. Radcliffe Cooke, one of the best authorities on cider of recent years, held that the quantity of cider produced annually reached a much greater figure than that already quoted, and concluded (in an article in the *Nineteenth Century* for 1901) that the total production was not less than 100,000,000 gal. a year. This is probably equivalent to a crop of 666,667–800,000 tons, or a yield of 200,000–240,000 tons of pressed pomace. Mr. John Ettle, late Horticultural Instructor for Somerset, from an intimate knowledge of the cider orchards in that county, reckoned in his evidence before the Departmental Committee on the Fruit Industry of Great Britain, 1904–1905, that the average orchard gave a yield of 275 gal. (5 hogsheads) per acre. The total acreage under cider and perry fruit probably being approximately 100,000 acres, this estimate corresponds to a total annual yield of 27,500,000 gal., *i.e.*, 183,333–220,000 tons of fruit, or 55,000–66,000 tons of pressed pomace.

The only actual figures of the yield of a typical English cider orchard which we have available are those from the old orchard at the National Fruit and Cider Institute. This orchard, well over 80 years old, and fast dying out, yielded crops in 1907, 1908, 1909, 1910 and 1911 at the rate of ¼ ton, 1 ton, 1⅗ ton, 1 ton and ⅗ ton per acre, respectively, without taking into account a small quantity of dessert and cooking apples which were not used for cider making. This orchard was 5 acres in extent, at least half of the ground was bare of trees, and the great majority of the trees were worn out and unproductive. It may also be mentioned as an established fact that yields of from ½ to 1 ton of fruit from single trees are by no means uncommon in some cider and perry orchards. On the strength of these figures, and at the same time making

* In the case of *apples* used on farms for cider-making the Board's estimate was 175 gallons from 1 ton of fruit.

allowance for the fact that many old orchards are in very similar condition to that mentioned, it seems probable to us that in an average year the total crop of cider fruit is not less than 200,000–250,000 tons, representing a yield of 60,000–75,000 tons of pomace. In any case it is evident that the total quantity available each season is sufficiently substantial to justify consideration of methods for its use.

Composition of Pomace.—The main constituents of the pressed pomace are carbohydrates, principally dextrose and lævulose, with starch and pectins which vary in quantity according to the state of ripeness of the fruit at the time of milling. In addition, smaller quantities of woody fibre and of nitrogenous bodies and fats also occur. The percentage of water is considerable and ranges from 60 to 80 per cent. of the total weight. Since the composition is practically the same as that of the fruit, minus the juice expressed, it follows that it will depend very largely upon the amount of juice extracted during the pressing. This is a very variable factor. It is affected by the efficiency of the mill and press employed, and also by the length of time to which the pulp is subjected to pressure. Further, the pomace is sometimes broken up again and pressed a second time; and in some districts a certain proportion of water is added, either before the first or second pressing, in order to aid the extraction of the juice. The percentage of residual soluble solids in the pressed pomace is in such cases somewhat reduced. The condition of ripeness of the fruit at the time of milling also affects the quantity of juice extracted, a larger quantity being obtained from ripe fruit than from fruit not quite ripe or, especially, over-ripe. Individual varieties of apples and pears vary greatly in composition, while the kind of soil upon which the fruit was grown, the age of tree, and the character of the season, also have much influence upon composition.

The table gives some figures showing the amount of nutrients in some typical samples of fresh pomace. Most of the analyses were made at the Bristol University Research Station. The authorities for the remainder are named. Corresponding figures for mangolds and wet brewers' grains are given for comparison.

It will at once be seen that the apple pomace is very variable in composition, though probably not more so than other fresh vegetable foods. Speaking generally, it is of distinctly higher feeding value than mangolds. It falls below wet brewers' grains as regards the amount of protein, but is richer in carbohydrates.

Composition of Pomace.

—	Mixed Apples. (Wolff.)	Mixed Apples. (Warcollier.)	Mixed Apples. (Lloyd.)	Mixed Apples. 1913.	Mixed Apples 1915.	"Bell" Apple. 1915.	"Ponsford" Apple. 1915.	"Cap of Liberty" Apple. 1915.	Pear. 1915.	1 Wet Brewers' Grains.	Mangolds (medium).
Water	74·3	78·15	72.4	74·0	76·05	68·39	75·39	75·37	65·52	76·2	88·0
Fat, etc. (Ether extract) ..	1·3	0·82	1·08	1·24	1·12	1·43	1·22	(1·20)	1·30	1·7	0·1
Protein	1·4	1·5	1·27	1·82	1·53	1·03	1·54	1·33	1.50	5·1	1·2
Crude Fibre	10·5	7·15	4·64	5·14	4·42	6·52	5·75	4·30	7·86	5·1	0·9
Ash	1·3	0·92	2·27	1·11	0·71	0·65	0·56	0·76	0·92	1·2	1·1
Carbohydrates (Sugar, etc.) ..	11·2	9·5	18·34	16·69	16·17	21·98	15·54	17·04	22·90	10·6	8·7

UTILISATION OF POMACE.

The chief difficulty to be faced in attempts to use pressed pomace is the rapidity with which decomposition sets in. The two principal changes which take place in the early stages are alcoholic fermentation and the production of acetic acid. These changes are brought about by what is called locally the "heating" of the pomace, a considerable rise in temperature taking place, and a great part of the sugar being converted into alcohol and acetic acid. The rate of these actions depends upon the prevailing temperature. Further changes leading to putrefaction occur if the pomace remains moist. It is, therefore, important that in all attempts to make use of this material it should be dealt with as soon as possible after it comes from the cider press. If it cannot receive immediate attention it should be stored in the coolest available place and be kept as dry as possible. The question of preservation is considered in a later section.

Pressed pomace has long been used on farms in the cider-making districts as a food for stock. Hogg and Graves Bull in the *Herefordshire Pomona* (1876-1885) mention also its use as a manure, and sometimes, on small holdings, as fuel when dry.

Cider makers in some instances employ the pomace for making a weak form of cider, "small" cider or "washings" (the French "petit cidre"), by adding a limited quantity of water and re-pressing. Another somewhat similar method, which has been investigated in some detail at the National Fruit and Cider Institute, consists in using it to improve low-grade ciders or those affected with acetification and other taints. These methods are considered below.

There are other possibilities which deserve consideration, such as using the pomace for vinegar production or for making cider and perry brandy; but they are somewhat complicated for farm purposes and will, therefore, not be further dealt with here.

There is also some prospect that profitable use could be made of the pectin content of pomace for industrial purposes. A product called "Apple Pectin" has recently been introduced into this country, and it is claimed that it will cause jams to set which will not readily do so themselves. Enquiries have shown that an article of this kind might prove very useful in the jam-making industry; and investigations are now in progress to ascertain if a suitable preparation could be obtained from cider pomace.

Pomace as a Feeding Stuff.—There are very few figures available for the proportion of the principal nutrients which

are actually digestible. Warcollier, in his book *Pomologie et Cidrerie,* quoting from Wolff's tables, gives for apple pomace a content of *digestible nutrients** of about 1 per cent. of protein, 1·2 per cent. of fat, and 12·5 per cent. of carbohydrates. The nutritive ratio* *i.e.*, the relative proportion of digestible proteins to carbohydrates and fats is about 1 : 16; and in these days of high-priced feeding stuffs, a waste material of this composition should on no account be neglected.

Most stock will eat apple pomace readily with enjoyment. In individual cases, cows will not take to it at once, but they can easily be got to like it by introducing small quantities at a time into their ordinary ration. There are, however, certain precautions to be observed in feeding this material In the first place, unless it has been properly preserved (a matter dealt with in the following section) it must be consumed *fresh.* As mentioned above, if left about exposed to the air the pomace undergoes a rapid acid fermentation in addition to putrefaction, and in warm weather it will be rendered unfit for food in two or three days. Secondly, very much better results will be obtained by feeding pomace mixed with more concentrated foods than by feeding it as a complete ration in itself, as is frequently done in this country. It should not form more than about one-third of the total ration.

In some districts a prejudice exists against feeding apple pomace, and it is true that if fed in too great quantities, especially when not quite fresh, some harm may result. In the case of cows, there is risk under such conditions that the milk may be tainted, and it has been reported that the consumption of very large amounts tends to cause abortion, though this has never been verified. There is, however, no risk of danger to stock if the pomace is used fresh and with reasonable moderation.

Preservation of Pomace.—The rapid deterioration of apple pomace and the necessity of feeding it whilst it is still fresh and sweet undoubtedly prevent an increase in its use as a feeding stuff. On farms and in small factories, where cider is made, the apples are all pressed during a short season in the autumn and early winter, and often more pomace is produced during this period than the stock can eat with advantage. Further, since in the cider-making districts nearly every farm has its orchard and press, little pomace can be disposed of in the locality, and it is not possible to send it any distance. Hence, any means for its preservation are of considerable importance.

* For clear explanations of these terms and their significance see the October issue of this *Journal* (Vol. xxii., p. 680).

Attention may, therefore, be drawn to the fact that pomace can be kept sweet and wholesome for a long time by converting it into a kind of silage. This plan is adopted to a considerable extent in the cider-producing districts of Normandy, but only in comparatively few places in this country.

The simplest method of making such apple silage is to pack the pomace in as fresh a condition as possible into some kind of silo. The silo may be improvised by using tubs or vats, or it may be specially constructed of masonry, or, where the soil is suitable, it may be dug out in the earth, the bottom and sides being covered with layers of straw. The pomace is pressed down very tightly in the silo—the more pressure the better—so as to include as little air as possible, and finally covered with straw and weighted in any convenient manner.

Another plan is to assist the preservation by the addition of from 5–10 per cent. of salt, giving a good sprinkling between each layer of pomace of about 1 ft. thick. By using considerable pressure, and thus keeping out the air, the whole mass becomes thoroughly consolidated, and only a very slow alcoholic fermentation takes place which does not interfere with the palatability or value of the silage. Pomace preserved in this way keeps well for a good many months and is of great value in case of scarcity of keep in the early spring.

Dried Pomace.—When dried, apple pomace is a comparatively concentrated food-stuff of much value. The process of drying cannot, however, be successfully undertaken on a small scale, and it is only in a few of the larger cider factories in this country that drying plants have recently been installed. The product is, according to report, sold to feeding-stuff manufacturers, and is employed in making compound cakes or poultry foods.

Pomace as Manure.—When for any reason apple pomace cannot be used for food it may, if properly dealt with, be turned into a very good manure. Much attention has been paid to this part of the subject in France, and a well-made compost containing pomace as its basis is looked upon as very valuable.

Ordinary samples of pomace contain from 0·2–0·6 per cent. of potash, 0·4–0·7 per cent of phosphoric acid, and 1·6–1·7 per cent. of nitrogen, so that it is richer in manurial constituents than farmyard manure. The continually increasing acidity is an objection to its direct application to the land, and in order to neutralise this it is usual to add chalk, marl or lime. This is well mixed with the pomace and some soil, and the heap is then allowed to stand for some time with occasional turning

until it is well rotted down. A good mixture would seem to be 4 parts of soil, 4 parts of pomace and 2 parts of lime.

A more ingenious device, which is frequently adopted in France, is to mix the pomace with a quantity of bone or mineral phosphates. The acid produced during fermentation is said to bring much of the insoluble phosphate present into a more readily available form, thus increasing the manurial value of both the phosphate and the pomace. In order to test this plan under English conditions, some experiments have already been started.

Pomace for Making "Small" Cider or for Improving the Quality of Low-grade Cider.—"Small" cider is made by pouring water on the pressed pomace, which has previously been broken up roughly, and allowing the moistened pulp to stand for a few hours, preferably overnight, in a wooden vessel before re-pressing. The expressed liquor is practically a diluted form of the residual juice in the pomace, and is treated in essentially the same way as pure juice for cider-making. Its quality obviously depends upon the proportion of water added to the pomace, and this should be determined by the purpose for which it is intended to use the small cider. In practice it is generally found that if water is added at the rate of 1 gal. to every 10 lb. of pomace the resulting juice possesses a specific gravity of 1010–1015. This is equivalent to a gain of 3–4 per cent. of sugar. The addition of a smaller proportion of water produces a juice of correspondingly higher specific gravity and richness in sugar. *In making small cider it is well to endeavour to obtain a specific gravity of 1030 in the freshly-expressed liquor.* This may be done either by reducing the proportion of added water, by expressing less of the pure juice from the pomace to be treated in the original, or by the addition of sugar. Small cider properly made is a pleasant light beverage, especially suitable for summer use on the farm.

A similar course of procedure is adopted for the improvement of inferior or tainted cider, the latter being used instead of the water for adding to the pomace as in making small cider. On most farms there is generally cider to be found which will benefit by this treatment, whether it be early-made cider from "windfalls," or acetified or otherwise tainted cider from a previous season's make. The manner in which taints in flavour are more or less completely removed by this process of "*re-soaking*" is very marked; and it seems probable that there is something more than a mere admixture of old cider and new juice taking place.

WOMEN'S WORK IN AGRICULTURE IN PEACE AND WAR.

By an interesting coincidence two official publications were issued in November relating to the employment and education of women in agriculture, one concerned with normal times* and the other with the present emergency.† A study of these documents will prove instructive both to the farmer and the educationist, and will probably lead to the conclusion that had it been possible in years of peace to carry out the recommendations made in the former it would not have been found necessary during the war to improvise methods in the manner suggested in the latter. It is proposed here first to review these publications, and then to give an account of the experiences of some farmers who have recently engaged women to take the place of men who have joined the forces.

Report of the Agricultural Education Conference.—The Board of Agriculture and Fisheries, some time before the outbreak of war, decided to refer to the Agricultural Education Conference the question of agricultural education for women. The enquiry was actually undertaken during the first six months of the current year, but the subject was looked at principally from the point of view of normal requirements without direct reference to the war. The Conference considered that the system of agricultural education in this country has been built up mainly to meet the requirements of men; and that, with very few exceptions, the instruction available for women consists of (1) courses in men's institutions which admit women students; and (2) additional short courses or classes for women, which are attached to institutions for men.

Rural Women.—In considering the education required for the wives and daughters of agriculturists (who constitute the great majority of rural women) there are two aspects to be remembered: one is how to make women do better the work in which they are locally engaged; the other is how to arouse interest in and initiate new forms of work which could profitably be carried on. As conditions often vary in different parts of the same county, the Conference were of opinion that the system of teaching must be elastic; that it must be brought

* Report of the Agricultural Education Conference on Agricultural Education for Women. Messrs. Wyman & Sons. Price 1s. 3d.

† Circular Letter to the Secretaries of the County War Agricultural Committees on the Employment and Training of Women (A 250/C and Memorandum).

to the doors of the women concerned; and that, while any scheme of instruction should in its main features be applicable to the whole country and to both sexes, the particular needs of women should be considered and their wants supplied.

The facilities offered to rural women consist of itinerant instruction, and in a few counties short courses at a farm school or similar institution. As the former is, however, the only method by which the great majority of the wives of small holders and cottagers can be reached, the Conference considered that the amount of instruction at present provided is totally inadequate. They also expressed the opinion that itinerant instruction should take the form of organised classes rather than lectures, especially in the case of poultry-keeping and horticulture. As regards farm schools it is pointed out that while there are twelve institutions which may be considered as coming under this head, the extent to which they provide agricultural education for women is very limited. Only two, in fact, attempt to teach any part of the practical side of agriculture in addition to dairying, and, therefore, fulfil the function of real farm schools. One may say, therefore, that except in the case of indoor dairy work there is practically no instruction in agricultural work offered to young women of the tenant farmer or small-holder class at any fixed institution. The Conference fully endorse the policy of the Board of Agriculture and Fisheries in encouraging the provision at fixed institutions in each county of courses suitable to the conditions of the district, and recommend that the curriculum provided for girls should include instruction in the care of animals, the minor farm processes, and domestic economy, including fruit-bottling and jam-making.

With regard to instruction in domestic economy, it is to be observed that while in Ireland, Belgium, and Canada instruction in home management forms the central feature of the agricultural education provided for women, and aims at improving the work of rural women in the home, no less than the farm and garden, in this country the facilities offered to rural women have, almost without exception, been restricted to courses of instruction and lectures in technical agricultural subjects, such as dairying and poultry-keeping. The Conference recommend that instruction in home management should be provided for women in any grouped course of agricultural education.

Women of the Professional Classes.—Another class of women requiring agricultural education includes women belonging to

the professional and land-owning classes, and the daughters of the larger farmers. They are drawn from the towns as well as the country, and take up this work as a definite profession from choice and not necessarily because they are born into it. For a woman of this type it is desirable, whether she intends to become a teacher or undertake a post involving management, that she should have some experience on the practical side. At an agricultural college male students get this form of training, not only in the actual processes of farm work, but in estate management, surveying, etc. While it is generally agreed that manual work should not form any large part of a college curriculum, it must be remembered that in the case of farmers' sons they can acquire knowledge of such work at their own homes, and that the sons of professional men who have had no previous experience are advised to gain their practical knowledge on an ordinary farm before coming to college. In the case of women, the proportion who have had no experience on the practical side is relatively large. For them, both in agriculture and horticulture, there have been definite difficulties in getting instruction on farms and gardens run on commercial lines. It is more essential, therefore, in their case that colleges should offer opportunities for learning the actual technicalities. It is for this reason that, in the instruction provided in the women's colleges at Swanley and Studley, practical work in horticulture takes a foremost place. An institution is badly needed in which women can learn the processes of agriculture which a farmer's son learns normally at home.

While the Conference consider that the absence of facilities for women analogous to the combination of practical and theoretical instruction provided for men at certain agricultural colleges indicates a definite want, they do not advocate the increase of the number of institutions of the collegiate type, but recommend that there is room for the provision, at one or more of the institutions, whether entirely devoted to women or not, of a systematic course in general agriculture, comprising both the practical and scientific side.

Action by the War Agricultural Committees.—From the above paragraphs it can easily be imagined that the system of agricultural education for women, inadequate for normal times, was quite incapable of meeting the demand brought about by the war for a large increase in the facilities for training women to undertake farm work. On this subject the President of the Board has addressed a circular letter to the War Agricultural

Committees and the Local Education Authorities, from which the following paragraphs are quoted :—

The question [of the employment of women in agriculture] has received the attention of the Departmental Committee on the Home Production of Food, who have recommended in their Final Report (Cd. 8095) that the War Agricultural Committees should organise an appeal to women living in their areas to offer their services to local farmers. Lord Selborne approves of this recommendation, and he thinks it is probable that there are many women qualified to undertake some branch of farm work, such as milking, who are not at present employed in agriculture and not aware that their services are required. Some of these might, if appealed to on patriotic grounds, be able in the present emergency to undertake farm work of a certain type. His Lordship, therefore, hopes that your Committee will arrange that women throughout the county be canvassed with a view to ascertaining the number in each parish willing and qualified to engage in agricultural work. In counties in which courses in buttermaking and cheesemaking have been held for some years the County Agricultural Staff could probably supply the Committee with a list of past students known to be efficient milkers and dairy-women, and Lord Selborne suggests that your Committee should take steps to secure that all such women are informed that there is a serious shortage of skilled farm workers and that their services would be greatly appreciated.

The Departmental Committee expressed the opinion that it is essential that farmers should offer efficient women workers a fair wage. Lord Selborne considers that it will be impossible to maintain the supply of woman labour for farm work unless an adequate wage is offered, and he trusts that your Committee will bring this to the notice of farmers employing women in your area.

Lord Milner's Committee further took the view that for women unacquainted with farm work some course of practical instruction is necessary, and they suggested that county committees might make provision for training women in their areas similar to that which has been made by certain local education authorities. The experiments which have been made in a few counties since the outbreak of war in training women for farm work have proved that it is possible, by providing selected women with short courses of training, to make an appreciable addition to the number of farm workers available at the present time. Lord Selborne has therefore had prepared, for the information of your Committee, a memorandum describing the methods adopted in different parts of the country with a view to fitting women to undertake farm work, and he trusts that your Committee will co-operate with the Committee responsible for agricultural education in your county in the preparation of a scheme for this purpose.

It will be seen that, in the case of the scheme initiated by the Board, out of 218 women who took a course of training of from two to four weeks, 199 are at present in agricultural employment. These women were all selected by the Labour Exchanges, and most of them had no previous knowledge of agricultural work. There is good reason to believe that similar results could be obtained in each county in England in which there is a farm school or agricultural college at which the training could be given. Where there is no such institution the county committees should consider the possibility of arranging for pupils to be housed at a farm on the lines followed in Nottingham. In this case,

however, Lord Selborne suggests that the farmer on whose land the women are to be instructed should be asked to nominate one of his regular employees to act as instructor, and that a small payment of, say, sixpence a day should be made to the instructor from county funds. In this way any opposition to imparting gratuitous instruction may be overcome.

The two schemes mentioned provided for the women being brought from a distance and housed at the place where the training was given. A much larger number of women can be dealt with if the course is not residential, and this is an advantageous feature of the scheme carried on with so much success in Cornwall. A scheme of that nature, however, would be successful only if the following essential conditions could be secured: (1) a number of efficient women farm workers available throughout the county to act as instructresses, and (2) great energy and patriotism on the part of the members of the County Committee and the Women's Committees formed in every parish.

In the light of this information, Lord Selborne confidently hopes that he will secure the co-operation of your Committee in initiating and carrying out the necessary measures for the employment of women in farm work in your area, and I am to suggest that the canvass of women in your area should be taken in hand immediately. If, as is probable in some counties, the number of local women available for agricultural work is found after the canvass is completed to be insufficient, the Committee should take steps to augment the number by obtaining through the Labour Exchanges women from neighbouring towns who are willing to undergo a short course of training on the lines already described.

I am further to say that any approved expenditure which the Local Education Authority incur in providing such instruction will be eligible for grant under the Board's Regulations.

War Measures.—The memorandum referred to in the above extract describes the experiments which have been made in different parts of the country since the outbreak of hostilities in the training of women to meet the shortage of labour on farms. It was realised soon after the outbreak of war, that in order to replace men withdrawn from agriculture for service in the military forces, it would be necessary to provide instruction, in some of the lighter branches of agriculture, for women who, hitherto, had had little or no experience of farm work. Further, it was evident that if a considerable number of women were to be dealt with it was impossible to provide them with prolonged courses of training. The object to be aimed at, therefore, was (1) in the case of women entirely unacquainted with agriculture, to give them an opportunity of becoming familiar with farm work (especially in association with other women), and thereby gaining some confidence in themselves before seeking employment as wage-earners; and (2) in the case of women already familiar with farm work, to provide them with opportunities of extending their knowledge and increasing their efficiency.

To meet these objects the following three methods have been tried :—

Cornwall County Council's Scheme. The object of the Cornwall Agricultural Committee and Sub-Committees was to organise a systematic and personal appeal among local women to offer their services to farmers, not merely in order to relieve the existing shortage of man labour, but to ensure that still more men might be released for the military forces. This object was accomplished by the formation of Women's Committees for each parish in the Education area, the members of which were responsible for a local canvass, the compilation of a register of women willing to work on the land, and the selection of a number of capable women competent to act as instructresses. These local instructresses were responsible for classes in such subjects as milking; the preparation of cattle foods; and feeding calves, pigs and dairy cattle. More advanced instruction in dairy work, if required, was undertaken by the regular County Staff Instructress. Classes by the local instructresses were also held in other branches of farm work, such as hoeing roots, harvesting hay and corn, lifting potatoes, weeding and gardening.

The usual arrangements were for a farmer who had an efficient dairywoman to place her and the required number of cows at the disposal of the parish committee. Similarly, a farmer would allow a competent woman to hold a class in turnip hoeing, or any other branch of light farm work, on his land. The farmer was required to continue to pay the instructress her regular wage, and she received, in addition, sixpence a day from county funds. In this way the number of women capable of working on the land was increased at very little cost to public funds. One feature of the scheme which should be mentioned was that the services of women unable to undertake farm work were also enlisted so as to relieve those women, who left their homes to work in the fields, of a part of their home duties, by mending the family's clothes, by cooking the dinner, &c.

For further information regarding the Cornwall scheme reference should be made to a pamphlet on the subject written by Mr. W. Hawk, the Chairman of the Agricultural Committee of the Cornwall County Council.*

Nottingham County Council's Scheme.—The Nottingham County Council Advisory Labour Committee arranged for eight women at a time to be housed at a farm-house in the county. The farmer allowed his farm to be used for the purpose free of rent, and gave a donation and weekly subscription towards general expenses. The women were selected by the Labour Exchanges from a large number of applicants, and the course of training lasted three weeks. Two courses were held. Four of the women worked on the central farm and four on two neighbouring farms. The farmers in each case arranged for the instruction to be given, and gave the women their breakfast and dinner, in return for the work done. The voluntary services of a matron superintendent were obtained to supervise the working of the scheme, and the assistance of the County Agricultural Organiser and the Instructor in Agricultural Processes were also secured.

* "Suggestions for the Assistance of Women's Committees appointed to organise the Labour of Women and Girls of Cornwall who are willing to help in Agricultural pursuits during the War." Published by the Cornwall County Council.

The pupils were given instruction in milking both mornings and afternoons, and they also assisted with calves, pigs and poultry, haymaking, root singling and hoeing, top dressing with artificials, cleaning and whitewashing cowsheds, gardening and pea picking. The course of instruction was too short to give a thorough training to the pupils, most of whom came from semi-urban districts and had no previous knowledge of farm work, but it enabled them to get accustomed to rural life and conditions, and gave the Labour Exchange an opportunity of judging of their ability to take situations which farmers had applied to them to fill. It is understood, however, that owing to the housing difficulty, and for other reasons, it was not easy to find suitable places for the women trained.

Scheme carried out by the Board of Agriculture and Fisheries through certain Colleges and Farm-schools.—The Board of Agriculture and Fisheries arranged with the Labour Exchanges and certain agricultural colleges and farm-schools, situated in different parts of England and Wales, for the training of a number of young women, who were willing to accept employment as milkers and to undertake light farm work. The Board undertook the payment of the pupils' travelling expenses as well as of their board, lodging and tuition at the institution. The women were selected by the Labour Exchanges, who undertook to place the women out on farms on completion of their training.

The scheme was in operation for 25 weeks and the women selected were in nearly every case without previous experience of agricultural work, many coming from urban employment. The length of the course varied from 2 to 4 weeks. In all, 218 women were passed through the course of training and of these 199 were placed in employment, and, so far as is known, are working satisfactorily. In an emergency scheme of this kind mistakes were inevitable, and a few unsuitable women were selected. It is also admitted that the two-weeks course was too short. But the figures given are alone sufficient to justify the statement that the scheme, regarded as an experiment, was successful. Moreover, much prejudice on the part both of the women themselves and of farmers has been overcome.

The difficulty experienced in placing the women after training varied greatly in different parts of the country. But recently the Labour Exchanges have reported an increasing demand for efficient women for employment by farmers, especially capable milkers. The wages received by women trained under the scheme varied from 5*s.* to 10*s.* weekly when board and lodging were provided, or from 14*s.* to 20*s.* weekly when they lived out, cottages and perquisites being provided in some cases.

Examples of the Employment of Women.—The following are examples of the experiences of farmers in the employment of women during the last sixteen months :—

(1) The farmer has about 100 milking cows, about 75 of which are usually in milk at the same time. In addition to these, the farm carries about 70 young stock. The labour hitherto required to carry on the dairy work efficiently has necessitated the employment of eight men and one dairy maid. At the outbreak of the war four of the men offered to enlist; two were accepted; the other two were at first refused but subsequently one of them was accepted. The

places of two of the men were filled with other men on the farm who could milk.

There were then available for the work of the farm one dairy maid and seven men, and these succeeded in carrying on the work by working overtime. Later on the farmer arranged with four young ladies that they should be employed in the dairy. These young ladies, housed in a cottage, do all their own housekeeping and cooking, and are treated in every way as the other employees. All four are in the dairy at 5 a.m., and milk till 8 a.m. One of the four spends five hours of the morning and afternoon in the milk room washing up bottles and being of assistance to the milkmaid, work formerly done by one of the men; the other three again milk from 2 till 5, and two of these three wash out the cow-barn and do odd jobs from 9.30 to 11.30. The remaining one stays at home and does the housework and cooking. Each one spends one week in the month in the milk room, and each one spends one week in the month doing the housework and house-keeping. The result is that three work for eight hours a day for seven days, and one works for six hours a day for seven days; one weekly half-holiday is given in the same way as to all employees on the farm. In addition to this, each man or girl in the dairy gets one Sunday off in every seven.

These ladies had not previously lived on a farm; within three weeks each was milking her own share of the total number of cows in the dairy, and doing 10 or 11 cows as required in the afternoon when any one of the men was away. They do the work as well as the trained men. As soon as these ladies were competent, the two men who had been temporarily employed on milking returned to their ordinary farm work. The farmer now has one more milker than he has had since the war began, and in consequence he is enabled to increase the number of cows that he milks, and, therefore, the amount of food that is produced.

(2) A large farmer in the South of England had his staff reduced by 14 men, and engaged five women. He reports that they are doing his dairy work well, and that the calf-rearing is being better attended to than before. He is anxious to obtain the services of two further women.

(3) A dairy farmer having 200 cows engaged two women to take the place of men. He found these so successful that he has now five women in his employment.

Another example of women's work in agriculture (in this instance in fruit growing) illustrates both the public spirit and the ingenuity shown by country women at the present time. The owner of a garden, scheduled under the American Gooseberry Mildew Order, was called to the Colours when the Army was mobilised in August, 1914. His daughter was left to carry out the requirements of the Order by herself. Finding that she could not get the diseased shoots removed in time, she put up a notice explaining her position and asking for voluntary help from ladies. The number who offered their services was more than she could employ. The work was rapidly carried out, and the Board's Inspector reported that "the garden was well tipped."

THE SELECTION OF WHEATS FOR SPRING SOWING.

R. H. BIFFEN, M.A.,

Professor of Agricultural Botany, School of Agriculture, Cambridge University.

WHEN it has proved impracticable to sow the whole of the land intended for wheat during the autumn months, the first possible opportunity for carrying out the work is usually taken in the spring.

As a rule, both the soil and weather conditions are unfavourable during January, and the operations have to be delayed until February. If sowing can be done early in the month the loss of a week or two of the winter is not very serious, for, owing to the slow rate of germination at the low temperatures usually prevailing then, the later-sown crops may catch up with those sown a little earlier. If, however, the sowing of the crop cannot be carried out before the middle of February, some consideration must be given to the variety of wheat which is to be sown. Up to this date it is reasonably safe to sow any of the ordinary autumn wheats. A week or so later such a course is decidedly risky; it may result in a moderate crop or it may fail to produce any crop at all. In the best of circumstances the crop may ripen so slowly that harvesting is impracticable until a month, or even more, after the normal date. Such a crop is especially liable to be destroyed by sparrows, and it may have to be cut, even if unripe, in order to save a portion of it. In the second case the plants grow vigorously throughout the spring, but instead of coming into ear at the end of May or in June they continue to produce quantities of foliage, and either no ears at all or far too few to yield a paying crop.

It is impossible to state precisely the date before which any given variety must be planted in order to prevent the crop from "running." It probably varies with climatic conditions as well as with the kind of wheat sown. As a generalisation one may safely say that the slowest-maturing wheats, such as Rivett's, require to be planted at an earlier date than moderately rapid-maturing wheats such as Squarehead's Master, whilst a fast-growing wheat such as Nursery may safely be sown at a still later date. Judging from the experience of last season, when an unusually large area of

wheat was spring-sown, two of the safest of the autumn wheats for sowing up to the end of February are Squarehead's Master and Little Joss. In fact both of these were sown on several occasions in March with satisfactory results. Such a course entails a considerable amount of risk, and it cannot be generally recommended. For March planting, or even for planting after mid-February, one of the rapidly-maturing spring wheats should be chosen. Some of these, especially if sown early in the year, yield as well as the late-sown autumn wheats, and the crops can generally be harvested at about the usual dates. Further, they can, if necessary, be sown still later in the season. One or two may be planted throughout April or even well into May with the certainty of securing a crop, though very late sowing means some delay in harvesting. It is, however, unwise to make too much use of this valuable characteristic, for late sowing is usually accompanied by a marked diminution in the yield of the crop.

Varieties of Wheat for Spring Sowing.—The varieties of wheat especially suitable for spring planting are April or April Bearded, Nursery, Red Marvel, Dreadnought, Red Fife, Burgoyne's Fife and Marquis. All of these may, if necessary, be sown after the middle of February, whilst some of them may be sown, with a reasonable certainty of securing a crop, as late as the end of April.

April, or April Bearded, is one of the most reliable wheats for late sowing. In most districts it may be planted with perfect safety up till the middle of April, and even when sown at so late a date the crop may be harvested soon after that of the autumn-sown wheats. Earlier planting is advisable, however, in order to give the plants an opportunity to tiller more freely.

The ears of this variety are slender, lax and bearded, red or reddish-grey in colour; the grain is red and appears to be slightly better in quality than that of most English wheats. The straw is slender and rye-like, but rarely abundant, owing to the deficient tillering capacity of the plants.

In purchasing this variety it is as well to enquire for April Bearded wheat in order to prevent confusion with Red Marvel, a beardless wheat occasionally substituted for it.

Nursery Wheat is an old English variety suitable either for autumn or spring sowing. It can usually be counted upon to ripen satisfactorily if sown before mid-April, but it is not so reliable for extremely late planting as April Bearded. When

sowings can be made in March it should be chosen in preference to April Bearded, as it usually produces a better crop.

The ears are broad, moderately dense and well set, with a pale, beardless chaff; the grain is red and better in quality than that of most of our wheats. The difference in strength, however, is not sufficiently great to warrant the millers in paying more than a few pence per quarter extra on this account.

Red Marvel, also known as *Red Admiral*, is a variety imported some years ago from France, where it is grown under the name of Japhet. It is a valuable wheat for early spring sowing, but, as a rule, it should not be planted later than the middle of March.

The ears are fairly large, somewhat lax, beardless, and of a dull white colour; the grain is red and distinctly poor in quality. The straw bends over as the crop matures and it is frequently discoloured and soft owing to the readiness with which the plants are attacked by rust. In spite of these obvious faults the variety can be recommended on account of its large crops of grain. These, from early sowings, may almost equal those of the autumn-sown wheats, but any delay in planting is followed by a very marked diminution in the yield.

Dreadnought (Hâtif Inversable), another wheat of French origin, is suitable for sowing not later than the end of February. It has relatively short, strong straw, which fits it admirably for sowing on rich, deep land. The ear is large and dense and the grain is of medium quality.

Red Fife, *Burgoyne's Fife* and *Marquis* form a group of wheats particularly suitable for spring sowing in districts where wheat of this type is known to do well. Their grain is of excellent quality and should command prices which would go far to make up for any deficiency in yield. A well-grown and well-harvested sample of Red Fife should command much the same price as the best of the wheat imported from Canada, since it can be used for blending or for the manufacture of the highest grades of flour in precisely the same manner as the Manitoba Hards.

Red Fife may be sown at any time from October to the end of April, but, judging from an analysis of the results of many experiments, sowings made in February give, on the whole, the best results. Nevertheless cases are on record of crops of 6 qr. to the acre from April sowings. Such a high

yield, however, is unusual; about 30 bush. per acre would generally be considered a good crop.

The heaviest crops recorded are from light, loamy soils, from soils overlying chalk, and from brick earth. Good average crops are also frequently grown on light, sandy soils. The cropping capacity, however, is very uncertain, and it is impossible to state very definitely the conditions which suit this wheat; consequently, advice on this point should be sought from the nearest experimental station, and, if the variety has not been tested locally, sowings should only be made on a small scale.

The ears are small, lax, beardless, and white in colour; the grain is red and almost always translucent, hard, small, and of high bushel weight. The straw is slender, and apt to be brittle if over-ripe, but generally stands satisfactorily.

In the West Midland counties a somewhat impure stock of this wheat has been grown for the last twenty years under the name of Cook's Wonder.

Burgoyne's Fife resembles Red Fife in its general appearance, but the straw is stiffer, the ears are usually a little larger, and the variety is, as a rule, a better cropper. The grain, however, is white in colour, and, though much better in quality than that of ordinary English wheats, it is not so "strong" as that of Red Fife. The variety is best sown early in the spring.

Marquis wheat is a recent importation from Canada which has been considerably recommended for spring sowing. At present it has not been tested sufficiently in this country for any real opinion as to its value to be formed. In most respects the variety is very similar to Red Fife, but it is capable of maturing in an even shorter period than that variety. Its yielding capacity appears to be about the same as, or possibly a little less than, that of Red Fife. The stocks grown in this country are far from pure, but as the "rogues" ripen at about the same period as Marquis the admixture is not particularly serious.

Very few comparative trials of the yielding capacity of these various spring wheats have been made up to the present, and although a large number of isolated records of yield are available they cannot be averaged fairly for purposes of comparison. The figures vary from 18 to 50 bush. per acre, or even more, but the differences are largely accounted for by variations in the date of sowing. Nevertheless the returns indicate that where wheats of the Fife class are known to succeed they should be sown in preference to any others. If

there is any doubt on this point, Dreadnought should be chosen for the earliest sowings, say until the end of February, either Nursery or Red Marvel for sowing until the middle of March, whilst April Bearded or, possibly, Marquis, should be selected for any later sowings.

Rate of Sowing.—Spring wheats must usually be sown a little thicker than autumn wheats. From 3 to 4 bush. per acre is the usual rate for drilling. As a rule, the earlier the sowing, the better the preparation of the seed-bed, and the richer the land, the less will be the quantity of seed required.

Manuring.—Unless the land is highly fertile, a dressing of ¾ to 1 cwt. of sulphate of ammonia and 2 to 3 cwt. of superphosphate per acre, should be applied at seed time, with the two-fold object of encouraging growth and hastening maturity.

NEW FEEDING STUFFS.

G. S. ROBERTSON, M.Sc.
East Anglian Institute of Agriculture, Chelmsford.

DURING the past year the prices ruling for meat and dairy produce have been abnormally high. This state of affairs is chiefly due to two main causes :

(*a*) The greatly increased cost of cattle foods.
(*b*) The increased consumption of meat.

One of the most effective means of reducing the cost of feeding would be to introduce on a considerable scale certain new and cheap feeding stuffs which in the past have been extensively used in other countries but which, up till now, have scarcely been known in this country.

India, Egypt, and other British possessions and protectorates grow large quantities of oil-bearing seeds which are little known in this country. After the extraction of the oil from the seeds the residue is made into cattle cakes, the feeding value of which is often very high. Examples of such seeds are Sesame seed, Niger seed, Safflower seed, and Ground nut.

Sesame Seed (Sesamum indicum) and Sesame Cake.

Sesame is an annual plant grown extensively in all the tropical regions of the globe. In India it is more generally grown as an autumn or winter crop in the tropical districts, and as a summer crop in the colder parts. In 1912–13 the estimated area in British India under Sesame was 4,164,045

acres, yielding 471,700 tons of seed. As the following table shows, the export of Sesame from the various tropical countries is considerable :—

Export.	*Tons.*	£
India (1913)	*112,200*	1,797,000
China (1913)	121,110	1,869,000
Turkey (1912)	12,000	—
Africa and Indo-China (1912 and 1913)	15,469	225,500
	260,779	—

Practically the whole of the seed exported from India found its way to Continental Europe, viz., Germany, Belgium, France, Italy, and Austria-Hungary. The following table shows the exports to these countries from India in the year 1913–14, and the total imports into several of these countries in 1913 :—

—	Exports from India, 1913–14.	Total Imports, 1913.
	Tons.	Tons.
France	22,207	27,370
Belgium	33,779	—
Germany	16,510	114,174
Austria-Hungary	19,342	26,201
Italy	14,293	—

Very little Sesame seed was imported into the United Kingdom ; a serious position has been brought about in the trade in Sesame seed from our Colonies and Possessions (especially India) as a result of the closing of German, Austrian and Belgian markets.

There are two easily recognised forms of sesame, one with black seeds and the other with white. The black seed form yields the best oil. The oil is obtained by expression in mills by the same process as that employed for extracting mustard oil. It has no smell and is not liable to become rancid. In India it is used largely for culinary purposes, anointing the body, in soap manufacture, and as a lamp oil. In many of its properties sesame oil resembles olive oil, and is similarly used. It is also extensively used in the manufacture of Indian perfumes.

Sesame Cake is very rich in protein and oil, and is widely used on the Continent as a substitute for linseed cake for milk production and for fattening all classes of stock. ; 2¼ lb. of sesame cake are roughly equivalent to 3 lb. of linseed cake. The cake is said to cause softness in the butter, and German

experience seems to indicate that it is liable to become mouldy and rancid if not carefully stored.

Various analyses of sesame seed and cake are given in the following table :—

—	*Seed.* Kellner.	*Cake.* Kellner.	*Cake.* Chelmsford (French manufacture).	*Cake.* Chelmsford (English manufacture).
	Per cent.	Per cent.	Per cent.	Per cent.
Moisture ...	5·5	9·5	8·5	9·3
Oil	47·2	12·6	11·1	11·9
Protein ...	20·5	39·8	37·7	44·5
Sol. Carbohydrates	15·0	20·6	16·8	20·9
Woody Fibre ...	6·3	6·8	17·1	4·5
Ash	5·5	10·7	8·8	8·9
	100·0	100·0	100·0	100·0

The above analyses of sesame cake are superior to the analysis of an average sample of linseed cake, and compare very favourably with that of decorticated cotton cake.

As regards digestibility and palatability, sesame cake is equal to the best cakes at present on the market. According to Kellner, 77 per cent. of the organic matter, 90 per cent. of the crude protein, 90 per cent. of the crude oil, 56 per cent. of the carbohydrates, and 31 per cent. of the fibre are digestible.

Digestible Constituents in Sesame Cake.

—	True Protein.	Oil.	Sol. Carbohydrates and Fibre.	Starch Equivalent
	Per cent.	Per cent.	Per cent.	Per cent.
Kellner	34·2	11·3	13·6	71·0
French Manufacture (Chelmsford)	32·3	10·0	14·7	66·7
English Manufacture (Chelmsford)	38·4	10·7	13·1	72·7

Manurial Value.—The cake contains 7·12 per cent. nitrogen, 2·6 per cent. phosphoric acid and 1 per cent. potash. The compensation value for each ton of the food consumed, according to Hall and Voelcker's system (1914), is—

62*s.* 3*d.* for the year of application, and
31*s.* 1½*d.* for the following year.

Niger Seed (Guizotia Abyssinica) and Niger Cake.

Niger seed belongs to the order *Compositae*. The seed is a native of tropical Africa, but it is cultivated as an oil seed in most of the provinces of India.

The seed is rich in oil, yielding about 16 gal. per quarter of seed. The oil is pale yellow or orange in colour with little odour and a sweet taste. In its drying properties it ranks between cottonseed and linseed oil. Commercially the oil is used for making paints, anointing the body, to a certain extent for cooking, and as an adulterant of the more valuable oils. Niger seed oil is reputed to be of use in cases of fracture and dislocation of bones among cattle.

The cake which is left after the oil has been extracted from the seed is used for cattle feeding, for which purpose, in India and elsewhere, it is greatly appreciated. Several samples of the cake have in past years found their way into Essex, and an average analysis of five of these samples is given below. As far as can be ascertained, the Essex farmers who used this cake seemed quite satisfied with the results they obtained.

	Niger Seed. 1 sample (Chelmsford). Per cent.		Niger Cake. Average (Chelmsford). Per cent.
Moisture	5·09	...	10·4
Oil	38·46	...	6·1
Protein	23·10	...	33·1
Sol. Carbohydrates	12·65	...	23·4
Woody fibre	15·58	...	16·8
Ash	5·12	...	10·2
	100·00	...	100·0

The percentages of fibre and the ash in the cake are somewhat high, but no doubt if the seed were crushed in this country the amount of these constituents could be materially reduced.

Digestibility.—R. Gouin, in "Alimentation Rationelle des Animaux Domestiques," records that the cake contains 26·5 per cent. digestible protein, 3·3 per cent. digestible oil and 24·0 per cent. digestible carbohydrates. According to Kellner the corresponding figures are 25·6 per cent., 4·4 per cent., and 18·8 per cent. respectively.

Manurial Value.—Niger cake contains 5·30 per cent. nitrogen and 1·72 per cent. phosphoric acid. The compensation value per ton of the cake consumed would, therefore, be—

43*s.* 7*d.* for the year of application, and
21*s.* 9*d.* for the following year.

Safflower Seed (Carthamus tinctorius) and Safflower Cake.

Safflower is grown extensively, amongst other places, in India, China, and Egypt. In India it is grown both for its flowers—the Safflower dye of commerce—and for its oil-yielding seeds.

The oil seed crop is grown to the largest extent in the Bombay Presidency where the area is usually 500,000 to 600,000 acres. Figures for the other provinces of India do not appear to be available. The seeds from the dye-yielding plants are also collected and form a supplementary source of safflower seed oil.

Two different processes for extracting the oil are in vogue. In the one the seeds are submitted to cold dry pressure either before or after husking. The second process consists of a hot dry extraction, or crude downward distillation. The yield of oil from the first method varies from 20–30 per cent. The oil is clear and light in colour, possesses pronounced drying properties, and is useful as a lamp oil and for culinary purposes. It readily saponifies with alkalies, and the free fatty acids obtained resemble linoleic acid obtained from linseed.

The amount of oil obtained by the hot extraction process varies from 25 to 37 per cent. This oil, however, is useless for both burning purposes and for food.

Voelcker, in the "Standard Cyclopedia of Modern Agriculture," gives the following compositions for the two kinds of Safflower cake:—

—	Safflower Cake.		Safflower Seeds Unhusked (Chelmsford).
	Decorticated (Voelcker).	Undecorticated (Voelcker).	
	Per cent.	Per cent.	Per cent.
Moisture	11·60	8·55	6·58
Oil...	7·70	9·73	25·67
Albuminoid Compounds	47·88	20·25	13·65
Sol. Carbohydrates ...	19·72	25·12	20·40
Woody Fibre	6·20	32·95	29·53
Ash	6·90	3·40	4·17
	100·00	100·00	100·00

Mollison records that cattle have to be educated to eat the cake, but that it has the advantage of keeping well and does not get mouldy. The cake is highly valued as a manure.

Earth Nut or Ground Nut Cake.

An account of this feeding stuff has already appeared in this *Journal* (July, 1915). The article indicates that it is a very

desirable feeding stuff and might be more widely used by the farmers of this country. The extent to which this is possible will naturally depend upon the available supply. In this connection it is interesting to note that the estimated production of ground nuts in British India has steadily increased from 94,419 tons in 1903-4 to 631,400 tons in 1912–13. Mollison says "a good crop on suitable land liberally managed will, on an average, yield from 3,000 to 3,500 lb. per acre." In 1906–7 the "foreign export" of ground nuts from India was 95,000 tons and in 1913–14 278,000 tons. French West Africa is the second largest exporter with an export of 188,000 tons in 1912, Gambia third with 67,000 tons in 1913; Nigeria exported 19,000 tons in 1913.

In 1913 France imported 523,000 tons of ground nuts and Germany 96,000 tons. The imports of ground nuts into the United Kingdom are known to be small.

Great progress in the cultivation of ground nut is being made in India by the introduction of new seed, and there is no reason to suppose that a steady supply of ground nuts will not be available for this country.

Prior to the war several Essex farmers had tried ground nut cake, obtained probably from France. Enquiries have elicited the information that in every case the farmers using the cake were very pleased with the results obtained.

The average analysis of six of these samples is as follows:—

	Per cent.
Moisture	9·5
Oil	7·3
Albuminoids	47·0
Sol. Carbohydrates	24·9
Woody Fibre	5·8
Ash	5·5
	100·0

It is held by some that ground nut cake has a tendency to become rancid. The liability in this respect, however, is not nearly so great as in the case of coconut cake.

The supply of these new cattle cakes at a reasonable price depends mainly on the willingness of the seed crushers in this country to crush the seeds. The writer has been in communication with a number of British seed crushers, with the object of finding out whether in their opinion the extraction of oil from any of the above seeds, and the manufacture of feeding cakes from the residues, could be carried on extensively in this country.

There seems to be a general consensus of opinion amongst seed crushers that this country could certainly compete suc-

cessfully with Continental states. The seed crushers point out, however, that they are under one great disadvantage. Whereas Continental seed crushers can readily find a market for the residual cakes, they cannot. They complain that it is difficult, if not impossible, to induce the British farmer to try any new feeding stuffs, and that, therefore, all their residual material has to be sold at a poor price for the manufacture of compound cakes. It is certainly curious and unfortunate that the British farmer will not buy, for example, sesame cake itself, but is perfectly willing to purchase it as a compound cake.

There is reason to suppose that large quantities of sesame seed and ground nuts are a glut on the Indian market at the present time. The excellent feeding value of the respective cakes has been established in practically every Continental country. Although elaborate feeding experiments would supply very interesting information respecting the relative feeding values of these cakes, there is no time at this stage for these. Sufficient data already exist to show that these feeding stuffs can be safely and advantageously employed in the feeding of all classes of milk and fattening stock. There is little doubt that the employment of these new cattle foods in this country would, in addition to reducing the cost of production of meat and milk, be a great step towards securing for the country an industry which, though connected intimately with our own possessions, has largely been centred on the Continent, particularly in Germany.

Reference: "The Commercial Products of India," by Sir George Watt.
Many of the recent statistics have been supplied by the Commercial Intelligence Department of the Board of Trade.

THE SELECTION OF POULTRY FOR BREEDING STOCK AND THE HATCHING OF CHICKENS.

AMONG the annual operations connected with poultry-keeping none is more important than the selection of stock for breeding, and the hatching and rearing of chickens.

Selection of Breeding Stock.—Whether chickens are required for table purposes or for egg production, it is a mistake to gather eggs for hatching indiscriminately from a large flock of fowls. A selection should be made of the most suitable birds. These should be separated from the rest of the flock, and either kept on a free range or in a run large enough to allow 20 sq. yds. for each bird. The run should be erected on untainted soil.

The birds to be placed in the breeding pen should be in perfect health, *i.e.*, they should not only be free from disease, but they should show vigour and activity. A little careful observation will soon enable the poultry-keeper to select the most suitable birds; health and vigour are indicated by the appearance of the eye, comb, and head, by the condition of the plumage, and by a certain pugnacity and tendency to range freely. Whatever kind of hen is chosen, the male bird should always be pure bred. Birds which are known to have suffered from disease should be excluded, even if they appear to have recovered completely.

Selection for Egg Production.—Judgment guided by the eye alone is not likely to be satisfactory where the object is to increase egg-production; it is necessary to know, so far as possible, which birds have laid best. If trap nests are not used the actual records of the hens will not be known, but it may be possible to select those which as pullets began to lay during October or November. A large proportion of such birds prove to be good layers. The birds chosen for the breeding pen should be hens which have actually proved themselves to be good layers, or *well-matured* pullets which have been bred from high-yielding hens.

In selecting a male bird to mate with hens or pullets it is very important to obtain a bird which has been bred from a hen known to be a good layer. The results of extensive experiments, as well as the general opinion of experienced breeders, indicate that the male bird is largely responsible for transmitting the capacity for high egg production, and it is important, therefore, to ascertain that he is bred from carefully selected stock.

Selection for Table Purposes.—A pen formed for the purpose of breeding table chickens should consist of birds of a recognised table breed or breeds; the individual birds chosen should possess good breast development, white flesh and legs, and small bones.

Age of the Stock.—As a general rule, two-year-old hens should be mated with a cockerel, while pullets should be mated with a cock. A cock retained for breeding should be separated from the hens during the moult. He should be generously fed both for a few weeks before and during the growth of the new feathers. Under exceptional circumstances very early hatched (January or February) cockerels may be mated with pullets. The cockerel must be pure bred and at least a month older than the pullets.

Number of Birds in the Breeding Pen.—The number of birds to be included in the breeding pen must be determined by the breed, the season of the year, and, to some extent, by the range available. In the early part of the season 6 hens of the heavier breeds may be mated with a male bird, while later on the hens may be increased to 10 ; in the case of the lighter breeds the number of hens may be rather higher.

Time to Mate.—The best time to mate the birds in the breeding pens must be decided by the purpose for which the chickens are required. Where possible one pen should be mated up in the autumn for producing *table chickens*, the spring prices being the best of the year. For *egg production* the best period for hatching is approximately between 15th February and 15th April, the heavier breeds being hatched in the earlier and the lighter breeds in the later part of this period. The birds should have an opportunity to settle down and become accustomed to their surroundings before eggs are used for hatching.

Hints on the Hatching of Chickens.—*Selection of Eggs.*—Only eggs of uniform size and shape should be used for hatching. They should be clean, of good shape, and not more than four days old.

Preparation of Nest and Sitting Hen.—The nest should be placed, if possible, on the bare earth of the house, or, if there is danger from rats, on the floor of a shed with 3 in. of earth beneath the nesting material. This should be of clean, bruised straw. The nest should be slightly hollow, like a saucer, and the box should be clean.

The hen should be docile (White Orpingtons, Rhode Island Reds, Old English Game, and Silkies are amongst the best) and not under 18 months old. She should be tested for at least 18 hours before the clutch of eggs for hatching is given to her. Before being set she should be carefully examined for vermin, and well dusted with a reliable insect powder. The number of eggs set should be regulated by the size of the hen, and the season of the year. In the late autumn and early winter 9 eggs for a small hen, and 11 for a large hen will be sufficient, but, later on, these numbers may be increased to 11 and 13 respectively. If the eggs have been obtained from a distance they should be rested, the small end up, for quite 12 hours before being placed under the hen. They should be placed in the nest *in the evening.*

On the morning of the second day after the eggs are put into the nest and every day afterwards, at the same hour, the hen should be fed. Maize is the best food for this purpose.

For the first few days the hen must be watched, and, if necessary, put back upon the eggs after being fed and watered. She will usually go back of her own accord. A dust bath should always be provided; no hen will sit steadily if badly infested with external parasites. After the eggs begin to chip she should not be allowed to leave the nest until all the chickens are hatched. It is a mistake to take the chicks out of the nest as they hatch; they should be left to the care of the hen. They do not require food for 24–48 hours after they are hatched.

Care of the Incubator.—The incubator should be placed in a room or building where the temperature is fairly even, where there is suitable ventilation, and where the floor is not subject to undue vibration. The machine should stand quite level.

The first step is to light the lamp, and run the machine empty at an even temperature of 100° F. for 24 hours before filling it with eggs. All eggs put in should be as nearly as possible of the same age. Very fresh eggs will hatch probably on the 20th day, while very stale ones may take as long as 26 days. Those which have been laid not longer than three, or at the most, four days before being put into the drawer are best. The eggs should be placed in the drawer so that the small end is towards the middle. After putting in the eggs, the drawer should not be opened for 48 hours; and until considerable experience is acquired the maker's instructions for working the machine should be followed. Every morning and evening, until the eggs begin to chip, the drawer should be opened, and every egg turned over gently and exposed to the fresh air. The time of airing should vary from a minute or two on the third and fourth days, to five minutes at the end of a week, and fifteen minutes or so by the 17th day. When the eggs begin to chip, the drawer should not be opened more frequently than once in 24 hours. With the Hearson type of incubator, the dry chicks should be lifted out once in 24 hours and put into a drying box, the remaining eggs being carefully and very gently moved with the chipped side upwards. With the hot-air type, in which the nursery is below the hatching tray, chicks need not be taken out until all are hatched and dry.

The chicks may well remain in the incubator after hatching for 36–48 hours. The brooder, or fostermother, should be ready for them some hours before they hatch, and for the first three days, from October to April, the inner or sleeping chamber should be kept at a temperature of not less than 90° F.

Testing the Eggs.—The eggs should be tested in a dark room, with the help of a testing lamp, on the evenings of the sixth

and seventh days. With a large machine it is best to make two testings on consecutive evenings, or the drawer may be kept open too long and the eggs become unduly chilled. Each egg put back into the drawer as fertile should be specially marked. The staler eggs may need re-testing on the evening of the fourteenth day, but this should not be necessary if all the eggs be of the same, or nearly the same, degree of freshness when first put in.

As far as possible the room in which the machine is running should be kept at an even temperature, but free ventilation should be given at all times. Fresh air is a necessity if the chicks are to hatch out strong.

Chicks hatched in December, January, and February grow faster and attain a larger size than those hatched in earlier or later months, but if the weather be very severe they may need a little care for the first three weeks. After the first few days, however, the inner part of the brooder should not be kept too warm.

Chicks hatched in an incubator can be satisfactorily reared by a hen; but in this case care should be taken that (1) the hen is thoroughly broody, (2) all chicks put under one hen are given to her on the same evening, late, (3) the chicks are not chilled when carried out. The hen should be fed before the chicks are put under her, and may then be left without food or water for 36 hours. The hen should be fed upon maize for a few days, and the chicks upon food suitable for them.* Finely-broken flint grit should be given to chicks when a day old and every day afterwards.

If water is provided, newly-hatched chickens should always be offered food before they are allowed to drink. The water should be quite pure and fresh.

NOTES ON BEET OR MANGOLD FLY.

A. D. IMMS, M.A., D.Sc.,

Reader in Agricultural Entomology, Manchester University.

FOR several years past sugar beet has been grown experimentally in this country, and during the last three seasons the industry has been placed on a commercial footing. In view of the new conditions entailed by the war and other factors it is likely that the area devoted to beet cultivation in England will increase. The establishment of a factory at Cantley, on

* *See* Leaflet No. 114 (*Feeding of Poultry*).

he river Yare, has provided a link between the growers and the onsumers, and it is capable of dealing with a far larger amount of sugar beet than is at present raised for the purpose in this country.* In view of the importance of beet cultivation at he present time and its possible future in this country, it may not to be out of place to give a brief account of one of its principal insect enemies—the beet or mangold fly (*Pegomyia hyoscyami* var. *betae*).

As early as 1737 the famous naturalist Reamur gave a description of the larva of an insect which he found mining the leaves of the henbane, and drew attention to its resemblance to the species attacking the leaves of the beet. At the present day we know that the two insects are almost certainly races of one and the same species. The flies attacking henbane, however, are paler coloured than those attacking beet. The former are known to entomologists as the species *Pegomyia hyoscyami* Panz., while the race which attacks beet and mangold is regarded as the variety *Pegomyia hyoscyami* var. *betae* Curt.

Distribution of the Beet Fly.—The beet fly is spread over the greater part of the British Isles and is widely distributed throughout Europe wherever beet, mangolds or spinach are extensively grown. The number of plants attacked by this insect is considerable, and includes, besides beet, mangold and spinach, such common weeds as henbane, deadly nightshade, orache, white goosefoot, nettle-leaved goosefoot. That the deadly nightshade serves as a food-plant of this insect has only recently been discovered by A. E. Cameron,† Board of Agriculture research scholar, working in the Department of Agricultural Entomology at Manchester University. In addition to studying the life-history of this species, Cameron has conducted some interesting experiments, which tend to show that the insect may be separated into distinct races exhibiting marked tendencies towards a particular food plant. Thus, he was unable to induce fertilised individuals reared upon deadly nightshade to deposit their eggs upon mangolds, and similarly *vice versa*. Furthermore, at Dartford, in Kent, where henbane and belladonna are grown on a large scale for the sake of their alkaloid bases, the former is heavily attacked by the insect while the latter plant remains unaffected. Further research requires to be prosecuted on this subject: it is desirable to ascertain, for instance, whether flies developed from larvae feeding on the wild henbane or on goosefoot will lay

* Orwin, C. S., and Orr, J., see this *Journal*, Vol. XXI., 1915, p. 969.
† *Annals of Applied Biology*, 1914, p. 43–76, 2 pls.

their eggs freely on mangold or beet. It has been definitely stated that certain of the thistles (*Carduus*), sow thistles (*Sonchus*) and dandelion (*Taraxacum*) harbour the insect, and that such weeds need to be kept clear from beet and mangold fields. It is further stated that the dock frequently harbours a leaf miner which appears to be *Pegomyia hyoscyami* var. *betae*, and that it would be wise to wage war against this plant. There is no record, however, so far as the writer is aware, to prove that the mangold fly has ever been known to feed on any of these plants. The common leaf miners of the dock are *P. bicolor* and *P. nigritarsis*, species closely allied to the mangold fly, but not known to attack either beet or mangold. There is, therefore, at present no proof that beet or mangold crops are liable to be attacked by flies which have been bred from weeds in the neighbouring hedgerows. It is desirable to ascertain whether any good is likely to accrue, before advocating the eradication of certain of our commonest weeds from the vicinity of beet and mangold fields.

Enquiries made by the Board of Agriculture, and by certain of the agricultural colleges who have grown sugar beet on an experimental scale, have failed to bring to light any records in England of the crop being attacked by this insect. The attacks of the fly are intermittent; in some years it is very destructive, as, for instance, in Ireland during 1904; at other times its numbers, owing to unknown factors, are so reduced that the insect may become for the time being a negligible quantity. Nevertheless, it is likely that the sugar beet crop will sooner or later suffer from the depredations of this insect.

Life History.—As regards the life-history of the mangold fly, the female insect deposits her eggs on the underside of the leaf of the food-plant, generally in neat, parallel rows. On hatching, the maggots mine the leaf, devouring the soft parenchymatous tissue between the upper and lower epidermis. This method of attack gives the leaves a blistered appearance; attacked leaves rapidly flag and wither during dry weather, and serious damage to the crop frequently supervenes. There are at least three broods of the insect in the year, the average time for one brood of the insect to pass through its life-cycle being about 36 days. There is a good deal of overlapping of the various stages owing to differences in the times of emergence, so that the eggs, maggots, pupae and flies are all found to occur simultaneously from June to September. During the cold months hibernation takes place in the pupal stage at about two inches below the surface of the soil near the food plant.

Methods of Control.—The concealed feeding habits of the larvae or maggots of this insect make it difficult to apply insecticides effectually. Spraying the plant in the seedling stage, which is the most vulnerable period in the life of the plant, offers the best chance of success. Paraffin emulsion is the spray solution most generally recommended, but it cannot be uniformly relied on. Experiments carried out by Cameron* on a small scale, using this emulsion with the addition of nicotine, were found to be more effective. This insecticide appears to be efficacious against the younger larvae and also acts as a deterrent against the flies depositing their eggs.

Cultivation under favourable conditions, conducing to the healthy and rapid growth of the seedlings, strengthens the plants at their most vulnerable period. Stimulating chemical manures are also for this reason valuable. As undecayed manure attracts the insect, farmyard manure should be applied in the autumn in order to give it time to decay before the flies appear in the spring.

Little is known of the natural enemies of the mangold fly. Cameron† found, from observations carried out over two seasons, that the percentage of parasites to the total number of insects that emerged was 23·4 per cent. in 1912, and 28·2 per cent. in 1913. During the month of September, 1913, it reached 43 per cent. It is likely, therefore, that the natural enemies are an appreciable factor in reducing the numbers of this insect.

The Turnip Gall Weevil.

THE Turnip Gall Weevil (*Ceuthorhynchus pleurostigma*, Marsh. = *Ceuthorhynchus sulcicollis*, Gyll.) is at times a source of considerable loss to the turnip and cabbage crops, though, owing to the fact that the weevil injury somewhat resembles the more serious "finger-and-toe" disease, the presence of the weevil is not always realised. In the case of finger-and-toe a fungus (*Plasmodiophora brassicae*‡) soil is responsible for the malformation of the root, while in the case of an attack by the weevil the growths are definite galls formed by the larvæ of the beetle. Care should be taken to distinguish between the two diseases, as the methods of control are different. The general appearance of roots attacked by the gall weevil is shown by Figs. 4 and 5, and the characteristic features of the disease are dealt with in the section on "plants attacked and nature of injury."

* *Loc. cit.*, p. 67. † *Loc. cit.*, p. 68.

‡ For further information on this disease see the Board's Leaflet No. 77.

FIG. 1.
Gall Weevil (× 10).

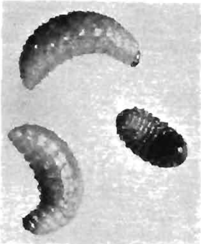


FIG. 2.—Larva (× 10).

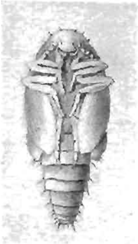


FIG. 3.—Pupa (× 10).

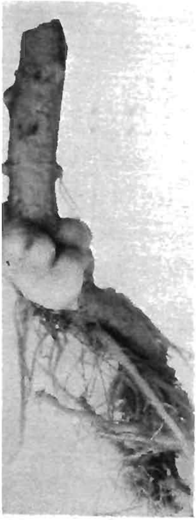


FIG. 4.—Cabbage Root.

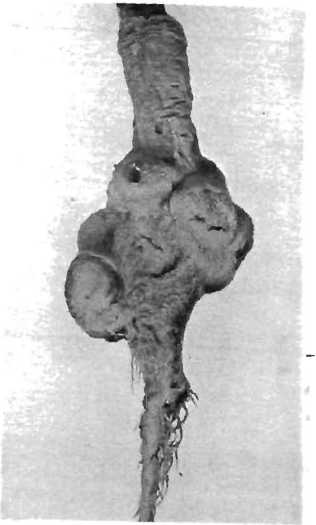


FIG. 5.—Turnip Root.

GS. 4 and 5.—Appearance of Roots attacked by Turnip Gall Weevil.

Description of Insect.—The *adult insect* is a small beetle about ⅛ in. in length with the long proboscis characteristic of the true weevils (*Rhynchophora*). In colour it appears to be black above and greyish on the underside, but if it be examined through a lens it will be seen that the upper surface is sparsely dotted with grey and white scales. The general appearance of the beetle is shown in Fig. 1. Several other species of the genus *Ceuthorhynchus* are harmful to turnips, *e.g.*, *C. assimilis*, the larva of which lives in the seed pods, *C. quadridens*, which in the larval state feeds in the stems of the flowering plants, and *C. contractus*, which as an adult attacks the seed leaves (*cotyledons*) of the young plant. The differences between these various species, and, in fact, between the genus *Ceuthorhynchus* and other allied genera of the *Rhynchophora*, are minute, and from the growers' point of view not worth entering into, since each species may be known by the form of injury it produces.

The *larva* (Fig. 2), is a small shining white or yellowish maggot with a brown head. It is legless, and is found inside the galls, usually in a curled-up or semi-circular position.

The *pupa* is white, and has the general form shown in Fig. 3. It lies in the earth in a cell formed of particles of soil glued together by a sticky material secreted by the larva.

Life History.—The adult beetles emerge from the pupæ in spring and summer, and the females then lay their eggs in or on the roots of the food plants. On hatching, the young larva feeds on the root, which is stimulated in some way so that it forms a gall such as shown in Figs. 4 and 5. The gall at first is small, but grows gradually until it may attain the size of a small marble, and in many cases several galls coalesce to form a single large outgrowth in which may be found a number of chambers each tenanted by a larva.

When full fed the larvæ bite their way out of the galls and enter the earth, where they form the cells described previously, and there pupate.

The length of time spent in the various stages seems to vary within wide limits. The larval period is said to occupy a minimum of 4 weeks and a maximum of 14 weeks, and it is sometimes stated that the majority of the larvæ leave the galls in autumn, a few only remaining until March. In opposition to this view were some observations made in the early months of 1914 and 1915, when there were received numerous specimens in which most of the galls were still tenanted by larvæ, none of which pupated before the month of March. The probable

explanation that is the beetles emerge irregularly in spring and summer, and that the eggs from those appearing early produce a second brood of beetles in late summer, which in their turn may perhaps give rise to a third brood in September. These later broods will also infect the turnip crop, and larvæ of various ages may be found in the same crop at the same time. The insect, therefore, may spend the winter either as a larva or pupa, and this point is of some importance in considering the various means of control.

Plants Attacked and Nature of Injury.—The various forms of turnip, mustard, charlock, rape, cabbage, Brussels sprouts, savoy, and kohl-rabi are attacked, but complaints most often refer to the turnip and cabbage. In the case of root crops the damage lies in the great loss of crop, which is most marked when the plants are attacked at an early stage. If cabbage plants are badly attacked they are much stunted and make little "head."

The growths produced by the weevil may always be distinguished by the fact that they are hollow and frequently contain a larva. The galls are always more or less rounded, and there is never a production of the elongated finger-like growths formed in an attack by "finger-and-toe." Roots injured by the beetle show little tendency to rot, even after the larvæ have left the galls, while the fungus usually causes extensive decay.

Distribution.—The turnip gall weevil is widely distributed throughout the United Kingdom, and records of its attacks have been received from most English counties. It is also well known on the Continent, and is said to be destructive in France, Russia and Germany.

From the economic standpoint it may be regarded as an insect which is present everywhere, and one which, under certain conditions, may increase sufficiently to cause serious damage. It is likely to become prevalent wherever crops of the cabbage and mustard family are widely grown from year to year, or where weeds of this family (such as charlock) are allowed to spread unchecked. On the other hand, it is controlled, though to what extent is unknown, by weather conditions and by its natural enemies, among which birds must be included.

Methods of Control.—(1) Where the turnip crop is attacked the turnips should be consumed as soon as possible so as to destroy the larvæ before they leave the galls.

(2) If a cabbage crop is attacked the stumps and roots should be burned.

(3) After an attack the land should be deeply ploughed to bury or destroy the pupæ. In the case of a garden, trenching may be resorted to or a soil insecticide may be dug in.

(4) It is better to avoid growing turnips or cabbages on land adjacent to that which has been attacked the previous year, and in no case should affected land carry in succession two crops liable to attack.

Notes on Feeding Stuffs in December: *From the Animal Nutrition Institute, Cambridge University.*

THE notes for the last two months have occasioned a considerable amount of correspondence. Enquiries on all subjects connected with foods and feeding are welcome, and any information possessed by the Institute will gladly be placed at the disposal of correspondents. It will facilitate early replies if correspondents will address their letters to Professor T. B. Wood, School of Agriculture, Cambridge. It may be added that Professor Wood would be very greatly obliged if readers of the *Journal* who have used any of the less known foods which have been suggested would be good enough to send a short account of their experience to the same address. These foods are being tried on the several farms over which the School of Agriculture has control, but it is desired to accumulate reliable knowledge of their properties, and this would be done much more quickly if readers would kindly adopt this suggestion.

This month's notes are on the same lines as before, except that in Table III. a new column has been included, column 5, giving the percentage of digestible carbohydrates and fibre in all the feeding stuffs. This has been done at the request of several readers of the *Journal* who wish to calculate the composition of the various rations suggested. Readers are reminded that the figures given are averages of the most reliable results of which records can be found, and that individual samples may differ considerably from the average figures given.

The following instance shows the kind of variation from the average figures which commonly occurs. Since last month three samples of ground-nut cake have been analysed, with the following results :—

	Sample 1.	*Sample* 2.	*Sample* 3.
Water	9·8	7·7	9·6
Protein	47·7	45·1	47·7
Oil	6·1	9·8	9·5
Carbohydrates	24·7	20·4	24·0
Fibre	6·5	11·5	4·7
Ash	5·0	5·5	4·5
	100·0	100·0	100·0

From these analyses the percentages of digestible nutrients and the number of food units per ton have been calculated, as follows :—

	Sample 1.	*Sample* 2.	*Sample* 3.
Digestible protein	42·9	40·5	42·9
Digestible fat	5·5	8·8	8·5
Digestible carbohydrates and fibre	21·6	18·1	20·6
Food units per ton	142·6	141·3	149·1

A sample of cake made from a mixture of soya bean and cottonseed, which is being largely sold under the name of Soycot, has also been analysed. It was found to contain 88 food units per ton. At £9 per ton this works out at a trifle over 2*s.* per food unit, which is just about the price of English linseed cake this month.

Comparison of Table II. with the similar table in last month's notes shows that all feeding stuffs have advanced in price. The average increase is 2*d.* per food unit, which corresponds to about 10*s.* to 20*s.* per ton, according to the number of food units in a ton. Individual increases vary from ½*d.* to as much as 4*d.* per unit. Ground-nut cake, palm-nut kernel cake, coconut cake, linseed cake, undecorticated cotton cake, oats and Chinese beans have risen in price only 1*d.* or less per unit. Malt culms, Burmese rice meal, bran, middlings, maize meal, linseed, linseed oil and peas (English dun and Calcutta white) have advanced 3*d.* or more per unit. Ground-nut cake is still the cheapest concentrated food on the market, and appears to be giving excellent results when judiciously used for fattening bullocks and sheep, and for milch cows. Once more readers may be reminded that ground-nut cake contains so much protein that unless the root ration is very heavy it should be mixed with a starchy food of some kind, such as maize, rice meal, dried grains or one of the wheat offals, whichever is most suitable for the purpose in view. The Institute is indebted to a correspondent who pointed out an arithmetical error in last month's notes in computing the proportions in which ground-

TABLE I.

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate prices per ton at the end of November.				Approximate prices per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya bean cake	1 : 1·1	122·3	10 0 0	10 10 0	9 10 0	9 17 6	1 7½	1 8½	1 6¾	1 7¼
Decorticated cotton cake	1 : 1·2	126·3	11 5 0	12 5 0	—	10 5 0	1 9½	1 11¼	—	1 7½
Indian linseed cake	1 : 1·9	123·1	—	11 15 0	—	—	—	1 11	—	—
English linseed cake	1 : 2·0	120·1	12 2 6	12 17 6	11 15 0	12 7 6	2 0¼	2 1¾	1 11½	2 0¾
Bombay cotton cake	1 : 2·5	65·3	9 2 6	8 10 0	8 10 0	9 0 0	2 9½	2 7¼	2 7¼	2 9
Egyptian cotton cake	1 : 2·1	71·9	9 7 6	9 0 0	9 0 0	9 7 6	2 7¼	2 6	2 6	2 7¼
Coconut cake	1 : 3·8	102·6	9 0 0	9 0 0	—	—	1 9	1 9	—	—
Palm-nut kernel cake	1 : 4·0	83·5	7 7 6	7 10 0	—	7 17 6	1 9¼	1 9½	—	1 10½
Ground-nut cake	1 : 0·8	145·2	*9 17 6	8 10 0	9 5 0	9 10 0	1 4¼	1 2	1 3¼	1 3¾
English beans	1 : 2·6	99·5	10 18 11	11 13 4	10 16 10	11 3 2	2 2½	2 4¼	2 2¼	2 3
Chinese beans	1 : 2·6	101·2	10 5 4	10 19 4	—	—	2 0¼	2 2	—	—
English maple peas	1 : 3·1	97·2	15 2 3	—	14 8 11	—	3 1¼	—	2 11¾	—
English dun peas..	1 : 3·1	97·2	13 15 7	—	14 8 11	—	2 10	—	2 11¾	—
Calcutta white peas	1 : 2·1	97·5	15 6 8	—	15 11 1	—	3 1¾	—	3 2¼	—
American maize	1 : 11·5	93·8	10 5 4	—	—	—	2 2¼	—	—	—
Argentine maize	1 : 11·3	94·2	9 2 0	8 19 2	8 16 2	8 15 0	1 11¼	1 11	1 10½	1 10¼
Maize meal	1 . 13	86·5	10 2 6	9 17 6	9 7 6	9 15 0	2 4	2 3½	2 2	2 3
Maize gluten feed	1 : 3·0	121·6	9 10 0	—	—	9 15 0	1 6¾	—	—	1 7¼
Maize germ meal	1 : 8·5	99·2	9 18 9	9 10 0	—	9 17 6	2 0	1 11	—	2 0
English feeding barley	1 : 8·0	83·0	12 6 5	—	12 3 7	12 9 2	2 11½	—	2 11¼	3 0
English oats	1 : 8·0	75·4	11 0 0	11 8 1	11 6 8	10 16 8	2 11	3 0¼	3 0	2 10½
Argentine oats	1 : 8·0	75·4	11 15 9	10 15 8	—	10 13 8	3 1½	2 10¼	—	2 10¼
Malt culms	1 : 3·6	69·9	7 0 0	8 0 0	7 0 0	6 10 0	2 0	2 3½	2 0	1 10¼
Brewers' grains (dried)	1 : 3·5	84·5	7 10 0	—	7 10 0	7 12 6	1 9¼	—	1 9¼	1 9¾
Brewers' grains (wet)	1 : 3·5	21·1	1 6 0	—	1 5 0	—	1 2¾	—	1 2¼	—
Egyptian rice meal	1 : 9·4	78·7	8 17 6	—	—	—	2 3	—	—	—
Burmese rice meal	1 : 9·4	78·7	8 0 0	8 0 0	8 0 0	8 12 6	2 0½	2 0½	2 0½	2 2¼
Wheat middlings	1 : 5·3	93·4	9 0 0	—	8 15 0	10 12 6	1 11	—	1 10½	2 3¼
Wheat sharps	1 : 5·0	86·3	8 15 0	10 2 6	9 15 0	9 12 6	2 0¼	2 4	2 3	2 2¾
Wheat pollards	1 : 5·3	81·9	—	8 5 0	—	—	—	2 0	—	—
Wheat bran	1 : 4·7	77·5	8 0 0	8 2 6	7 15 0	8 2 6	2 0¾	2 1¼	2 0	2 1¼
Wheat bran (broad)	1 : 4·7	79·9	8 10 0	8 12 6	8 10 0	8 12 6	2 1½	2 1¾	2 1½	2 1¾
Feeding treacle	—	60·0	9 0 0	9 0 0	—	—	3 0	3 0	—	—
Linseed	1 : 5·9	153·5	18 3 6	18 0 0	18 6 2	17 10 0	2 4½	2 4	2 4¾	2 3½
Linseed oil	—	250·0	33 15 0	36 0 0	31 2 6	40 8 11	2 8½	2 10½	2 5¾	3 2

* 2nd grade £9 2s. 6d.

nut cake and dried grains should be mixed in order to yield a mixture having a nutritive ratio of 1 : 2, or about the same as a mixture of linseed and cotton cakes. The equivalent mixture should have been given as 2 lb. of ground-nut cake and 3 lb. of dried grains, which will have a nutritive ratio of about 1 : 1¾, and will contain about 6½ per cent. of fat.

Suggested Rations for December.—No considerable change in the conditions of feeding has occurred since last month's notes appeared, except the general rise in the price of feeding stuffs. It does not, therefore, appear necessary to make more than a few detailed alterations in rations.

For Horses on Farm Work.—It does not seem possible to economise on last month's rations. The price of most of the

TABLE II.

Average Prices per Food Unit.

	s.	d.
Brewers' grains (wet) ..	1	2½
Ground-nut cake ..	1	3¼
Maize gluten feed ..	1	7
Soya-bean cake	1	7½
Coconut cake	1	9
Decorticated cotton cake	1	9¼
Brewers' grains (dried) ..	1	9¼
Palm-nut kernel cake ..	1	9¾
Maize, Argentine.. ..	1	10¾
Linseed cake, Indian ..	1	11
Maize germ meal ..	1	11½
Wheat pollards	2	0
,, middlings ..	2	0¼
Linseed cake, English ..	2	0½
Malt culms	2	0½
Wheat bran	2	0¾
Rice meal, Burmese ..	2	1
Beans, Chinese	2	1¼

	s.	d.
Wheat bran (broad) ..	2	1¾
Maize, American ..	2	2¼
Wheat sharps	2	2½
Beans, English	2	3
Maize meal	2	3
Rice meal, Egyptian ..	2	3
Linseed	2	4¼
Cotton cake, Egyptian	2	6½
,, ,, Bombay ..	2	8¼
Linseed oil	2	10
Peas, English dun ..	2	11
Oats, Argentine.. ..	2	11¼
,, English	2	11½
Barley, English feeding	2	11½
Feeding treacle	3	0
Peas, English maple ..	3	0½
,, Calcutta white ..	3	2

ingredients has gone up considerably, but with the present scarcity of horses and labour it is scarcely justifiable to recommend cheaper mixtures containing foods which have not been tried by the Institute.

For Breeding Mares and Foals.—See notes for October and November.

For Milch Cows.—It has been pointed out to the Institute, and it is certainly the case, that the rations suggested last month are considerably below the feeding standards commonly accepted for milch cows. There seems no reason, however, to alter the suggestions. The rations suggested are the most economical rations the Institute dare recommend in war time,

and are based on experience with the herd of milking shorthorns on the University farm. On these rations full-grown cows have been found to milk steadily through the winter without losing an undue amount of live-weight and to finish the winter in fair store condition.

The feeding standards referred to are based on experiments made by German investigators with continental fodders on

TABLE III.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Per cent. digestible.				
Name of Feeding Stuff.	Nutritive Ratio.	Protein.	Fat.	Carbo-hydrates and Fibre.	Starch equiv. per 100 lb.	Linseed Cake equiv. per 100 lb.
Foods Rich in both Protein and Oil or Fat.						
Ground-nut cake	1 : 0·8	45·2	6·3	21·1	77·5	102
Soya-bean cake	1 : 1·1	34·0	6·5	21·0	66·7	88
Decort. cotton cake ..	1 : 1·2	34·0	8·5	20·0	71·0	93
Linseed cake, Indian ..	1 : 1·9	27·8	9·3	30·1	77·1	101
Linseed cake, English ..	1 : 2·0	26·7	9·3	30·1	76·0	100
Cotton cake, Egyptian ..	1 : 2·1	15·5	5·3	20·0	40·0	53
Cotton cake, Bombay ..	1 : 2·5	13·1	4·4	21·5	37·6	49
Maize gluten feed	1 : 3·0	20·4	8·8	48·4	87·4	115
Brewers' grains, dried ..	1 : 3·5	14·1	6·6	32·7	50·3	66
Coco-nut cake	1 : 3·6	16·3	8·2	41·4	76·5	101
Palm-nut kernel cake ..	1 : 4·0	12·5	7·7	32·0	63·0	83
Linseed	1 : 5·9	18·1	34·7	20·1	119·2	157
Fairly Rich in Protein, Rich in Oil.						
Maize germ meal	1 : 8·5	9·0	6·2	61·2	81·0	107
Rice meal	1 : 9·4	6·8	10·2	38·2	68·4	90
Rich in Protein, Poor in Oil.						
Peas, Calcutta, white ..	1 : 2·1	23·3	1·1	45·9	66·9	88
Beans, English	1 : 2·6	19·3	1·2	48·2	67·0	88
Beans, Chinese	1 : 2·6	19·6	1·7	47·9	67·0	88
Peas, English maple ..	1 : 3·1	17·0	1·0	50·0	70·0	92
Brewers' grains, wet ..	1 : 3·5	3·5	1·5	8·6	12·7	17
Malt culms	1 : 3·6	11·4	1·1	38·6	38·7	51
Cereals, Rich in Starch, not Rich in Protein or Oil.						
Barley, feeding	1 : 8·0	8·0	2·1	57·8	67·9	89
Oats, English	1 : 8·0	7·2	4·0	47·4	59·7	79
Oats, Argentine	1 : 8·0	7·2	4·0	47·4	59·7	79
Maize, American	1 : 11·5	6·7	4·5	65·8	81·0	107
Maize, Argentine	1 : 11·3	6·8	4·5	65·8	83·5	110
Maize meal	1 : 13·0	5·5	3·5	63·9	77·8	102
Wheat middlings	1 : 5·3	12·0	3·0	56·0	59·1	78
Wheat sharps	1 : 5·0	12·0	4·0	50·0	58·4	77
Wheat pollards	1 : 5·3	11·6	3·5	53·0	54·1	71
Wheat bran	1 : 4·7	11·3	3·0	45·0	49·7	65
Wheat bran, broad ..	1 : 4·7	11·3	3·0	45·4	48·1	63

continental breeds of cows. They are supposed to give the amount of food which will enable a cow of known weight to yield a certain weight of milk without losing weight. It is recognised that with the ration suggested the cows will lose in live-weight, but only as much as will bring them back to fair store-breeding condition in the spring. The cows on the University farm are closely watched during the winter so that

the ration of each cow may be raised or lowered to meet individual requirements. If a cow shows signs of laying on flesh her ration is lowered. If she looks poor it is raised. This practice may be commended to all who wish to get the best out of their stock in these times of dear feeding stuffs.

For growing heifers or for cows intended to be ready for the butcher as soon as they are dry a heavier ration per 1,000 lb. live-weight should be used. It may also be advisable to give heavier rations to other breeds less liable to lay on flesh than shorthorns, as, for instance, Dutch or Holsteins and Guernseys. The suggested rations are for cows weighing about 10 cwt. live-weight. Larger cows will require, of course, larger basal rations of roots, hay, straw and concentrated food. The whole ration should be increased by about one-tenth for each increase of 1 cwt. in live-weight.

Bullocks, Calves, Sheep and Pigs.—For fattening bullocks, stores intended for grass beef next summer, stores in the yards, calves, fattening sheep, ewes heavy in lamb, and for fattening pigs, see last month's notes.

For the information of anyone who wishes to feed higher are given rations based on the usually accepted feeding standards. The basal ration is the same as that given last month, namely, 56 lb. roots, 8 lb. hay, 12 lb. straw, and 5 lb. of concentrated food made up of 3 lb. bran, 1 lb. linseed cake, and 1 lb. decorticated cotton cake. It is in the additional food for each extra gallon of milk that the feeding standards differ from the recommendations made—*i.e.*, these notes recommended about 2 lb. of concentrated food as above for each extra gallon above 2 gal. per day. According to the accepted standard the amount of concentrated food per extra gallon of milk should be about 3½ to 4 lb.

The Farm Orchards of Herefordshire.

EVERY farm in Herefordshire has at one time or another possessed its orchard of cider, perry, dessert and cooking fruit. All the old orchards are in grass; the trees are all on the old free stocks and are of the standard form so as to admit of cattle and sheep grazing below them.

A fairly wide range of varieties of ***apples*** are grown, whether for cider, dessert or cooking purposes. Some of the more modern varieties are being introduced into the old orchards, but in many cases they suffer from the domination of the old trees to such an extent that they are either unable to make rapid

headway or are completely suppressed. There are great possibilities for apple culture in the county, the effect of the soil (over the Old Red Sandstone) being to produce a colour and finish on the apples which cannot be attained in the other large apple-growing districts.

Pears, for perry making, are found in great variety, and, although very old, are remarkably healthy and vigorous. Some of the small pears are of good flavour and, if worked on the quince, might improve in size.

In these old orchards, *plums* are found to a less extent than apples and pears. *Cherries* are grown in some districts, especially in the vicinity of Bromyard, but the trees do not give the impression of being so healthy and vigorous as in well-managed Kent orchards, and they are usually grown at a greater elevation in Herefordshire.

Pollination troubles are scarce, both cooking and dessert varieties seem to bear well and regularly, and varieties of apples like Annie Elizabeth, Lane's Prince Albert and Cox's Orange Pippin, which are often faulty croppers, seem to benefit by the pollen of the cider varieties which are usually equally distributed throughout the orchards. In the same way the cropping of the more modern dessert and cooking varieties of pears is assisted by the interplanted perry varieties.

At several centres in the county there are commercial growers with large plantations of bush apple and pear trees on the paradise and quince stocks, and also on the crab and free stocks.

Need for Proper Treatment.—Generally speaking, the old farm orchards have, until recently, been very much neglected, and the need for proper manuring and drastic pruning and spraying is urgent.

The Education Committee of the Hereford County Council are at present conducting a competition with a view to the improvement of these orchards, the condition of the herbage as regards freedom from weeds, and value for grazing purposes being taken into account in judging improvement. The competition is so arranged that awards are made on the actual improvement effected, thus offering the greatest inducement to the owners of the worst orchards. Very considerable improvements are already discernible in the size of fruit, although where trees are old it will be some time before any great change is apparent. If a sufficient number of farmers

enter the present competition, and the scheme is carried through, the general standard of cultivation cannot fail to be improved.

Marketing.—A further direction in which great improvement is possible is in picking, grading, packing and marketing; the great bulk of the farm orchard fruit is carted to market in a very rough fashion after being roughly removed from the trees. After the general standard of cultivation has been raised the next step should be to teach farmers to pick, grade, pack and market their cooking and dessert fruit to the best advantage.

Further, much of the cider and perry fruit is allowed to go to waste in outlying districts, surplus fruit either being left to rot or being fed to pigs. Only the large growers attempt to sell their fruit to cider makers, and prices in recent years have, unfortunately, not been very remunerative.

War Food Societies.

THE Board have issued a revised edition of their Special Leaflet No. 32 (*War Food Societies*), copies of which can be obtained, free of charge, on application to the Board. The leaflet includes the following notes:—

Since the outbreak of war the Board have issued a number of leaflets with the object of affording some guidance to allotment holders, gardeners, and others who desire to increase their supplies of home-grown food, but printed information will not enable an inexperienced person to make the most of his opportunities. Many who would gladly add to their supplies of food, do not know how to set about getting possession of a plot of ground, or how to buy suitable manures, or how to select the best varieties of potatoes, cabbages, etc., for the purpose they have in view. To assist such people the Board think that local societies might be very useful.

The objects of such societies should be to secure an increased production of food, both by improving the methods adopted in existing gardens and allotments and by obtaining additional land for the use of those who are willing to cultivate it.

Most country villages are well supplied with gardens and allotments, but their management often leaves much to be desired, and they should be capable of producing much more food under skilled guidance and advice. In urban and suburban areas the allotments are usually well managed, but,

as a rule, there are too few of them, and War Food Societies might do most valuable work in such areas by obtaining the use of additional land for cultivation. Excellent work has been done in this direction by the Home Food Culture Society, Victoria Viaduct, Carlisle, which has obtained from land-owners in Cumberland and Westmorland a number of plots of land, free of rent, rates and taxes, for use as allotments. The Society provides technical advice and organises a supply of seedling plants. Similar work is being done in London by the Vacant Land Cultivation Society and by the Church Army.

How to Start a Society.—The initiative in forming a society may be taken by any local resident, but it is desirable to secure in all cases the co-operation of members of the town, urban district or parish council, which is the authority responsible for the provision of allotments. The chairman of the local authority might be invited to call a meeting of local residents, allotment holders, etc., to consider whether a society should be formed and, if so, to appoint a small committee. Where there is already a gardening or allotment society in existence it might be used as a nucleus. The Agricultural Organisation Society, Queen Anne's Chambers, Tothill Street, Westminster, London, S.W., will be glad to advise or assist in the formation of societies. The registration of societies under the Industrial and Provident Societies Act or the Friendly Societies Act is not essential.

Methods of Work.—The methods to be adopted will vary with the local conditions. If it appears that there is a demand for additional allotments which is likely to be permanent, the society should urge the town, urban district or parish council to use its statutory powers to acquire land for the purpose. Where the demand is for the temporary use of land for cultivation during the war, the society should ascertain what vacant or uncultivated land is available in the district, and approach the owners or agents for permission to cultivate it. In order to meet objections on the ground of the liability for the payment of compensation, it may be desirable to avoid the creation of a tenancy and to ask only for a licence to enter and cultivate the plots for specified purposes. In rural parishes there is usually a sufficiency of land, and in such places the society should mainly direct its attention to securing increased production and preventing waste.

Supply of Seeds, Manures, Plants, etc.—The society should endeavour to organise the supply of seeds, manures, plants, tools, feeding stuffs, &c., for the use of its members, and it

might arrange to purchase these in bulk from a local agricultural or industrial co-operative society. In many cases landowners may be willing to supply, free of charge, a number of seedling plants from their own gardens.

Disposal of Produce.—The society should endeavour to see that, as far as possible, the gardens or allotments are used for the production of food for home consumption. It is most desirable in these times that each household should produce as much food as possible for itself, and so save money and also reduce the consumption of food which has to be imported from abroad. If there is any surplus produce, the society should try to organise its collection and sale to a local agricultural or industrial co-operative society or to the local tradesmen. It is desirable to enquire from any possible purchasers the class of produce which is most needed in order to advise what should be grown.

Advice.—Societies should make a point of obtaining expert advice in their work. Reference should be made to Special Leaflet No. 25 (*Technical Advice for Farmers*), which contains particulars of the system which has been set up for providing expert advice on all agricultural questions, and gives the names and addresses of the persons from whom advice can be obtained in each county. In addition, special war agricultural committees have been established by the county councils in most counties and districts, and their assistance should be sought in cases of difficulty. In most rural villages the landowners and principal residents will be ready to lend the services of their gardeners for instruction and advice, and in many cases also the village schoolmaster is competent to give a great deal of help.

Suggestions for Work.—Some suggestions for the work of War Food Societies are also given in the leaflet. The subjects touched upon are the growing of vegetables, goat-keeping, pigs, poultry, preservation of eggs, rabbit-breeding, pigeon-breeding, bees, preservation of fruit, collection of acorns, etc., rough hay and litter, and bracken. Readers may obtain from the Board leaflets on most of these subjects, as indicated in the leaflet referred to.

The suggestions do not, of course, apply equally to all the societies that might be formed. Urban or suburban societies would usually concern themselves with gardening, or with gardening and poultry-keeping, while in the country pigs could be kept, and food and litter collected to supplement what was grown.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

The Valuation of Basic Slag (*Devon County Agric. Com., Rept. on Field Expts.*, 1912–14).—The value of the phosphate in basic slag which is soluble in citric acid was compared with that which is insoluble, both in pot and field experiments.

In the pot experiments with oats, although the best crop was obtained from the slag containing the highest proportion of citric soluble phosphate, the yields from slags containing lower percentages were not proportional to these percentages ; it was clear that the oat plant could readily utilise the phosphate which was insoluble in citric acid. It was also shown that the insoluble phosphate in basic slag is active enough to feed such a short-lived plant as mustard, and that the phosphate soluble in citric acid is not of any more value than the insoluble phosphate for this crop.

In the field experiments with turnips the following average results were obtained :—

Centre 1.			Centre 2.		
Solubility of Slag.	Weight of Crop.		Solubility of Slag.	Weight of Crop.	
Per cent.	Tons.	cwt.	Per cent.	Tons.	cwt.
19·4	22	17	19·5	8	11
13·8	21	19	7·74	6	4
33·3	23	16	33·59	11	15
17·3	21	10	13·24	11	17

It is concluded that the extraction of basic slag with a 2 per cent. solution of citric acid does not give a true value of the utility of the basic slag, the insoluble phosphate having considerable value.

Reclamation of Bog Land.—In their *Journal* for July, 1915, the Department of Agriculture and Technical Instruction for Ireland publish an account of some experiments which are at present in progress in Ireland on the reclamation of bog land.

As the manurial treatment of Irish bogs appears to differ from that of Continental bogs, a series of pot experiments was undertaken with samples of peat obtained from different localities, some from the surface, others from the cut away portion of the bog. With a few exceptions lime was found to be the controlling factor ; in fact it was in most cases found impossible to grow cruciferous crops such as rape without lime, while cereals generally died out after a brief existence. In the majority of cases the effect of the absence of phosphate was more marked than that of nitrogen, while potash was invariably the least important of the four manurial ingredients.

In 1914 a small scale experiment was laid down in the Bog of Allen The bog (known locally as "red bog") was dug over during the previous winter and left to weather, with the intention of growing a crop of potatoes in 1915. The analysis was as follows (per cent.) :—Water 16·87, organic matter 79·21, calcium oxide ·19, nitrogen ·31, potash

* A summary of all reports on agricultural experiments and investigations recently received is given each month. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.

0·26, and a trace of phosphoric acid. Rape, rye, and potatoes were sown on 20th June.

The young rootlets of the *rape*, on the untreated plot, and those on the plot that received no lime, appeared as if burnt up as soon as the seeds germinated, with the result that not a single plant lived. Very little growth was made where nitrogen or phosphate was omitted from the dressing, and, while the want of potash was not nearly so marked, its omission from the complete dressing with lime considerably decreased the yield.

The *rye* germinated on the untreated plot, but was a complete failure afterwards. No grain was produced where no lime was given, and the result was but little better where no phosphate was given. A fair growth was made without nitrogen or without potash, but the grain here was merely "tailings." A fairly good crop both as regards grain and straw was obtained from the complete dressing (including lime).

The *potato* trial indicated that this crop is not so dependent on lime as rape or rye, and that a deficiency of phosphate is as great a drawback as a deficiency of lime. The following figures show the approximate yield per acre :—

	Tons.	cwt.
Untreated	1	0
Nitrogen, phosphate, and potash	1	17
Nitrogen, potash, and lime	1	14
Phosphate, potash, and lime	2	15¾
Nitrogen, phosphate, and lime	3	0
Nitrogen, phosphate, potash, and lime ..	5	0

When the short time the peat had to weather after it was dug over, and the lateness of the season when the crops were sown, are taken into account the results may be considered fairly satisfactory for a first crop.

It would appear that fair crops can be grown on some classes of unreclaimed bog land with artificial manure and lime without the use of farmyard manure, provided the mechanical conditions as regards moisture are favourable.

FIELD CROPS.

Varieties of Wheat (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—Squarehead's Master gave much better returns in corn and straw than Svalöf and Tystofte. The first-named produced 4 bush. per acre more corn than Tystofte and 12 bush. more corn than Svalöf; it gave the heaviest weight per bush. and was valued highest.

Varieties of Barley (*Woburn Field Expts.*, 1914; *Jour. Roy. Agric. Soc.*, 1914; *J. A. Voelcker, D.Sc.*).—The yields of grain, in bush. per acre, were :—Tystofte Prentice 45·8, Archer 44·8, Svalöf Primus 42·9. Tystofte Prentice also gave the highest priced grain, while Svalöf was much the earliest variety.

Varieties of Spring Wheat (*Univ. of Leeds and Yorks. Co. for Agric. Educ., Rept. No.* 97; *J. Potts, B.Sc., N.D.D.*).—On a medium loam spring wheat followed swedes (carted off) after barley. Seed was drilled at the rate of 4 bush. per acre on 26th March, a dressing of ¾ cwt. sulphate of ammonia, 1 cwt. superphosphate, and 1 cwt. steamed bone flour being previously applied. Red Fife was cut on 31st August,

and Red Marvel and Dreadnought on 9th September. Spring-sown Victor was also tried, but appeared to be a variety requiring a longer period for maturing than can in an ordinary season be secured by sowing as late as the end of March. The yields were as follows, per acre: Dreadnought 36¼ bush. grain, 32 cwt. straw; Red Marvel 35¾ bush. grain, 30½ cwt. straw; Red Fife (Irish seed) 25 bush. grain, 29 cwt. straw.

A monetary valuation of grain and straw was obtained with the following results per acre: Red Marvel, £11 6s. 5d.; Dreadnought, £11 3s. 6d.; Red Fife, £8 15s. 1d. Dreadnought was a little later than Red Marvel in maturing, and would doubtless have yielded a better sample of grain had it been sown earlier in the spring. Red Fife gave a splendid sample of grain, but owing to its disappointing yield its cultivation is not recommended in Yorkshire.

FEEDING STUFFS AND DAIRYING.

Significance of the Act of Milking (*Paper read at the British Association Meeting*, 1915; *C. Crowther, M.A., Ph.D.*).—Data were adduced in support of the view that, in addition to removing milk previously formed, the handling of the teats may impart a stimulus to further vigorous secretion during the period of milking.

The milk from the "quarter" of the udder milked first had a tendency to steadily increasing fat content as the quarter was emptied, a tendency which was much less pronounced with the subsequent "quarters" milked, although in the case of all four quarters there was a rapid rise in the percentage of fat towards the close of milking. When the quarters were milked in pairs the results from the first pair resembled those from the first quarter, and those from the second pair those from the last quarter; when the four quarters were milked simultaneously the results from each resembled those from a "first quarter." The milk from the quarter milked first was almost invariably the richest in fat, and that from the last quarter the poorest.

The foregoing observations led to the conclusion that the time-factor must be of considerable importance in milking. This was confirmed by a comparison of very quick and very slow milking by ordinary methods, which showed a difference of 10 per cent. of milk-yield and 40 per cent. of fat-yield in favour of the quick milking

A further comparison was made of ordinary milking, taking the teats in pairs, and simultaneous milking, by two milkers, of all four quarters A difference of 2 per cent. in milk-yield and 6 per cent. in fat-yield in favour of the latter method was indicated, despite the occasional disturbance of the cow inevitable with this mode of milking. Further tests with the milking-machine are proposed.

The Importance of the Fibre Content of Concentrated Foods (*Paper read at the Agric. Educ. Assoc. Meeting*, 1915, *by J. Porter, B.Sc.; summarised from "Farmer and Stockbreeder,"* 20th and 27th September, 1915). This paper emphasises the *mechanical* as distinguished from the *chemical* effect that concentrated foods are likely to have on the bulky part of the ration. Cereal straws and concentrated foods which are rich in fibre require a large amount of energy for mastication and digestion, thus reducing the surplus nutrients (after maintenance) available for the production of meat and milk. A further point is that, to get the best results from feeding, the food must pass through the animal's body

neither too quickly nor too slowly; the fibre has a binding, the oil a laxative, effect. Dry and fodder crops are binding, while succulent and immature fodder crops have a laxative tendency, turnips being generally more laxative than swedes. When the bulky part of the ration is laxative, concentrates rich in fibre could be used as correctives, especially when poor in oil, and *vice versâ*.

Provided the concentrated part of the ration contains sufficient albuminoids, is palatable and sufficiently laxative, it does not seem to matter from what source the concentrated part of the ration is derived.

The results of various experiments with cows, fattening cattle, sheep and pigs are qnoted in support of the above contentions.

The following feeding standards are given by Mr. Porter for the concentrated part of the ration: For *dairy cows* receiving hay or straw and roots—albuminoids 15 to 20 per cent., oil 4 to 6 per cent., fibre (not exceeding) 10 per cent. For *fattening cattle* and *sheep*, where fodder crops and roots are being supplied in fairly liberal quantities: early stages of fattening—albuminoids 15 to 20 per cent., oil 4 to 6 per cent., fibre (not exceeding) 15 per cent.; later stages of fattening—albuminoids 20 to 25 per cent., oil 6 to 8 per cent., fibre (not exceeding) 10 per cent. For *pigs* the best standard for a pig meal is: albuminoids 10 to 15 per cent., oil 2 to 4 per cent., fibre (not exceeding) 6 per cent.

Composition and Digestibility of Various Kinds of Straw (*Landw. Versuchs-Stat., Bd.* 84, 1914).—To eliminate soil and manurial conditions the different kinds of straw examined were taken from the same farm; but to test the effect of weather, the samples were selected both in the dry year of 1911 and the wet year of 1912. The results were as follows:—

Straw.	Crude Protein.	Pure Protein.	Carbohydrates	Crude Fat.	Crude Fibre.	Pentosans.	Ash.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1911 (dry year).							
Oat	3·35	3·25	45·36	1·73	42·84	26·21	6·72
Winter barley ..	5·02	4·65	45·95	1·54	42·06	25·93	5·43
Spring barley ..	4·00	3·80	45·34	1·40	44·29	26·10	4·97
Winter wheat ..	2·63	2·46	47·02	1·12	46·26	25·68	2·97
Spring wheat ..	2·74	2·61	44·47	1·85	46·61	27·41	4·33
Winter rye ..	3·36	3·21	42·73	1·78	48·59	26·65	3·54
Spring rye ..	3·68	3·44	48·51	1·83	42·99	26·07	2·99
1912 (wet year).							
Oat	2·96	2·66	41·67	1·62	49·03	26·41	4·72
Winter barley ..	5·49	5·29	43·00	0·89	44·55	26·70	6·07
Spring barley ..	3·56	3·39	42·01	1·39	45·79	27·03	7·25
Winter wheat ..	4·78	4·58	42·06	0·88	47·86	25·11	4·42
Winter rye ..	3·80	3·50	45·34	1·62	45·75	26·48	4·49
Spelt	2·74	2·52	42·09	0·93	46·93	27·59	7·31

The small differences, if any, compared with early analyses of straw, revealed by the above table are taken to show that the effect of modern plant breeding in producing stronger strawed varieties has had hardly any effect on the composition of the straws. Further, although it has been asserted that the straw of winter varieties contains more fibre than that of spring varieties of cereals, this is not borne out by the results of the analyses.

Experiments were carried out with wethers and the following digestible constituents found :—

Straw.	Pro-tein.	Carbo-hydrates	Crude Fat.	Crude Fibre.	Dig. Albu minoids.	Starch Value.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Oat, 1911	0·36	21·68	0·74	22·96	0·26	21·44
„ 1912	0·16	15·63	0·71	29·71	—	18·26
Spring rye, 1911 ..	1·17	23·24	0·95	23·43	0·97	24·43
Winter rye, 1911 ..	0·76	17·43	1·11	26·68	0·61	17·97
„ 1912 ..	1·03	16·01	0·83	25·91	0·73	16·82
Spring wheat, 1911..	0·15	18·14	0·08	23·35	0·02	15·61
Winter wheat, 1911..	—	18·34	0·48	21·19	—	13·38
„ 1912..	2·49	15·65	0·50	22·40	2·29	13·15
Spring barley, 1911..	0·62	20·40	0·62	24·23	0·42	19·61
„ 1912..	0·83	16·38	0·54	25·51	0·66	16·71
Winter barley, 1911..	0·47	22·24	0·95	24·98	0·10	24·26
„ 1912..	2·62	17·80	0·50	22·05	2·42	16·99
Spelt, 1912	1·15	13·64	0·59	21·92	0·93	10·04

These figures show, on the average, a starch value of 19·34 for the straw of spring cereals and of 16·10 for that of winter cereals, and on this basis the former would have the higher feeding value, in spite of the fact that there are no real differences between the crude fibre contents of the two sorts.

The influence of the weather on the composition appears to be relatively small, or, at least, not so great as with the protein rich fodders like meadow hay and clover hay. The digestibility of the spring straws does not seem to differ materially from that of the winter straws ; both seem to have a higher value than the straw of rape and rape seed, and a value about equal to that of the straw of leguminous crops.

DISEASES OF PLANTS.

Spraying Trees in Winter (*Jour. Bath and West Soc.*, 1914-15 ; *B. T. P. Barker, M.A.*).—This experiment was designed to test the effectiveness of spraying trees in the dormant condition. Eggs of Red Spider, Larger Winter Moth, Mussel Scale, and Apple Psylla were used, and the spray fluids were applied to infested twigs and bark in the laboratory.

Red Spider proved very resistant to all the washes. The Apple Sucker was also little affected by the sprays, excepting a 3 per cent. caustic soda solution which killed both eggs and shoot. The Larger Winter Moth appeared very sensitive and was affected by washes of paraffin ; paraffin and naphthalene ; caustic soda ; and caustic potash both alone and along with paraffin, and paraffin and naphthalene. Washes containing caustic potash most influenced the Mussel Scale, and hatching was greatly reduced or entirely prevented. It is emphasised that very different results might have been obtained under field conditions.

POULTRY.

Variation in the Physical Characteristics of Eggs (*U.S. Dept. of Agric., Bur. of An. Ind., Bull.* 110, *Pt. III.; Raymond Pearl, Ph.D., and F. M. Surface, Ph.D.*).—The data set forth in this bulletin were based

on examination and measurement of about 5,500 eggs from Plymouth Barred Rock pullets. Among the conclusions reached, the following may be mentioned :—

Eggs are relatively more variable in length than in breadth, and are considerably more variable in shape than in either of the linear dimensions, length or breadth ; the weight and volume of eggs are much more variable than any of the other characters. All the egg dimensions studied were found to be positively correlated with each other in varying degree. Egg length and egg breadth are correlated only slightly, and neither the weight nor the volume appears to be to any extent correlated with the shape. There is a high correlation between volume and weight, implying that the specific gravity of the egg varies only very slightly.

It was found that the relative variability of eggs is a definite characteristic of the individual, some birds characteristically laying eggs which are extremely variable and other birds characteristically producing uniform eggs. The investigators believe that many of the results found for eggs of the Barred Plymouth Rock will also obtain for the eggs of other breeds.

Bad Effect of Acorns on Laying Hens.—A case in which bad effects on laying hens were ascribed to the feeding of acorns is described in a recent issue of the *Deutsche Tierärztl. Wochenschrift.* In addition to other food each hen received about 1 oz. of shelled, dried and powdered acorns per day. As a result egg-laying diminished and then ceased, although it was spring at the time. A dirty brown discoloration of the skin of the yolk and also of the yolk itself was noticeable. There was no stoppage.

The bad effects were attributed to the astringent effects of the tannin in the acorns on the very sensitive ovary capillaries, while the brown discoloration of the yolk was the result of oxidation. It was thought, also, that the tannin may have affected the assimilation of the proteins in the foods fed, and in this way also hindered egg production.

Steeping the acorns in water is recommended to remove the tannin, but the investigator did not test this point.

Three days after acorn feeding was discontinued laying was resumed and gradually increased.

FORESTRY.

"Brown Oak" and its Origin (*Annals of Botany,* July, 1915, *P. Groom, M.A., D.Sc.*).—In certain individual British oak trees the ordinary heartwood is partially replaced by a rich-toned, often reddish, brown wood, which is firm and hard, and is termed " brown oak."

" Brown oak " is due to a fungus living exclusively in the heartwood ; the fungus presumably infects solely, through a wound, trees sufficiently old to possess heartwood.

" Brown oak " usually occurs at the base of the trunk, and the adjoining root, and generally tapers upwards in the stem and downwards in the root ; but the fungus can gain entrance to upper parts of the tree, and so produce in these regions masses of " brown oak " even in individuals devoid of it in their lower parts.

The fungus in the infected tissue is responsible for the production of a brown substance (or substances) highly resistant to solvents, [illegible] rmed

The fungus (and colour change) advances most rapidly longitudinally and transversely; the advance in a tangential direction is comparatively slow.

"Brown oak" can remain firm and hard in the tree for a long time; where decay occurs there is no reason to believe that it is due to this fungus. The tortoiseshell variety of mature "brown oak" is due to the longitudinal darker bands traversing normal coloured wood in the early stages of conversion of heartwood into "brown oak."

The advance of the process of browning is arrested or obstructed by large knots, though burr-wood with numerous small knots may be completely brown.

Tannin is suggested as one of the sources of the food of the fungus.

OFFICIAL NOTICES AND CIRCULARS.

Agriculture and Recruiting.

1. THE President of the Board of Agriculture and Fisheries desires to draw attention to the terms of the Circular of 19th November which has been issued to Local Authorities by the President of the Local Government Board, so far as it relates to agriculture.

Local Authorities have been invited to do everything in their power to assist the work of the local Recruiting Authorities and to constitute committees to deal with questions arising in connection with the new recruiting arrangements. These committees are to be styled "Local Tribunals" and a Central Appeal Tribunal has been appointed by the Government, with Lord Sydenham as Chairman, to deal with cases referred to them by the Local Tribunals.

2. It has been arranged by the War Office that a man who wishes to join the Army may elect either to join the Forces forthwith or to be placed in his group; that is, (*a*) he may be enlisted for immediate service with the Colours, or (*b*) he may be attested, placed in the Reserve (Section B), grouped, and returned to his civil occupation until his group is called up for service.

A man accepted on the latter conditions will be entitled as a soldier in the Reserve to wear a khaki armlet which will be given to him by the Military Authorities.

There are 46 groups, 23 for single men (including widowers without children dependent upon them), each year of age constituting a separate group, and 23 similar groups for married men; the first group consisting of single men aged 18 years, the forty-sixth of married men aged 40. Men married since the 15th August, 1915, the date of registration, will be treated as single men. It is proposed to call up the groups for military service in the numerical order of the groups, except that men of 18 years will not be called up for service in any case until they attain the age of 19 years.

3. Certain classes of skilled agricultural workers have been starred in addition to those employed in other industries, and a list of reserved occupations has also been prepared which includes certain occupations in trades allied to agriculture. The Army Council have issued instructions to all Recruiting Officers that starred men and men on the list of reserved occupations who wish to join the Army shall not be enlisted

their civil occupations They will be provisionally exempted from actual service, and will not be called up unless it is decided by the Central Appeal Tribunal that it is no longer necessary in the national interest for them to continue to be provisionally exempted.

The Recruiting Officer may raise a question whether the occupation of any man is, in fact, a starred or a reserved occupation, or whether it is necessary, in the national interest, that the man be still retained in civil employment. The Recruiting Officer must bring the question before the Local Tribunal, who are then to investigate the case and report thereon, with their recommendations, to the Central Appeal Tribunal for decision.

4. There are also the cases of men who are actually engaged in a starred occupation, but who have not been "starred." It will be open to the man or his employer, in a case of this kind, to make an application on the prescribed form in duplicate to the Tribunal for the area in which the man's place of employment is situate, on the ground that the man is in fact, engaged in a "starred" occupation. Forms for the purpose may be obtained from the Clerk to the Local Tribunal.

If the Recruiting Officer agrees to the application the man will be treated as though he had been "starred," and the Local Tribunal will then need only to notify the fact to the man or the employer as the case may be. If, on the other hand, the Recruiting Officer does not assent to the application, the Local Tribunal are to investigate the facts and to report with their recommendation to the Central Appeal Tribunal. If the Central Tribunal decide that the man is engaged in a "starred" occupation the man is to be treated as though he had been "starred."

5. If any "starred" man has inadvertently been enlisted for immediate service with the Colours, the employer should write at once to the Area Commander, whose name and address can be obtained either from the local Recruiting Officer or from the Clerk to the Local Tribunal, the War Office having promised to take all possible steps to transfer the man to the Army Reserve and send him back to civil occupation.

6. In the case of a man who is not in the list of "starred" or "reserved" occupations, but who may be individually indispensable to an employer's business, the employer may bring the case of any such man—if he has been attested, grouped and passed into the Reserve—(but not if he has been enlisted for immediate service with the Colours) before the Local Tribunal with a view to his being placed in a later group, but in these cases the man himself must also state that he is willing to remain in the employer's service if the claim is allowed, and the man's consent to this is therefore made a condition precedent to any claim by the employer.

If the Recruiting Officer raises no objection to the claim, the case may be treated as decided, and the Local Tribunal will notify the employer accordingly. Failing agreement, the Local Tribunal will decide whether the man should be placed in a later group, and, if so, in which group. It is not competent to the Local Tribunal in a case of this kind to decide that a man is to be provisionally exempted from service and not to be called up with the group in which he is placed.

The Local Tribunal cannot place a man back more than 10 groups, but if, when the time comes to call up the group to which the man has been postponed, the circumstances continue to be such as to justify his

being placed in a still later group, application to this effect may be made to the Local Tribunal by the employer or the man as the case may be.

It is important to bear in mind that an application can be made in respect of a man in this class only if he is attested and grouped in the Reserve, not if he enlists and immediately joins the Colours, and there is no obligation on a Recruiting Officer to see that a man who is not starred or included in the list of reserved occupations joins the Army under the condition that he is placed in his group. It will therefore be well that employers who may wish to make a claim in respect of any such men desiring to join the Army, should point out to them that they should join under the condition that they are attested and grouped in the Reserve.

The term "indispensable" will be strictly interpreted. It will not be enough for the employer to show that he will be inconvenienced, even seriously inconvenienced, by the loss of the man. Speaking generally the employer will have to show not only that the man is individually indispensable, but also that every effort has been made to obtain a temporary substitute for him, and that the employer has given reasonable facilities for men in his employment to enlist.

7. Farmers themselves, in common with other employers, have not been "starred," but as it is essential from the national point of view that there should be someone on each farm to direct the business, and ensure the proper cultivation of the land, Lord Selborne considers that farmers of military age who desire to join the Army should not enlist for immediate service with the Colours, but should be attested and grouped in Section B, Army Reserve. If a farmer remains on his farm it should be possible for him in most cases to release his son for military service unless that son is really indispensable to the cultivation of the farm owing to the enlistment of the skilled labourers.

8. Lord Selborne feels sure that in this time of critical need and in view of the arrangements made for the retention of the skilled and indispensable men, farmers and other employers of agricultural labour will do all in their power to adapt themselves to changed conditions and that by the employment of men not eligible for military service, by the employment of women (which can be very much extended), and by the reorganisation of their business generally they will do their very utmost to release men for His Majesty's Forces.

Recruiting of Skilled Farm Workers.

WITH regard to the recruiting of skilled farm workers, Lord Selborne desires it to be clearly understood that if a skilled agricultural labourer who has been "starred" as such leaves his employment on the farm in order to take up other work not connected with agriculture, the "starring" of that man will cease to be operative and he will be liable to be canvassed and enlisted for immediate service with the Colours.

Children and Home Production of Food.

CHILDREN living in country districts can assist in increasing the home production of food in many ways. At present, if their parents keep pigs or other live stock, they can help to reduce the cost of feeding by collecting acorns and horse chestnuts, rough grass, etc., for use as fodder. They can also help to economise [illegible] collecting dried bracken, grass, leaves

and reeds. Suggestions for the use of these materials are given in leaflets issued by the Board of Agriculture and Fisheries, viz., Special Leaflet No. 9 (Acorns, Horse Chestnuts and Beechmast), Special Leaflet No. 10 (Pig-keeping for Cottagers and Smallholders), Special Leaflet No. 34 (Autumn and Winter Fodder), and Special Leaflet No. 38 (Use of Bracken as Litter). Copies of these leaflets may be obtained free of charge and post free on application to the Board, Whitehall Place, London, S.W.

Importation of Live Stock into New Zealand.

THE Government of the Dominion of New Zealand have modified their requirements relating to the importation of cattle, sheep and swine from the United Kingdom which, for the purposes of the amended regulations, is regarded as three separate countries, viz. :—(1) England and Wales, (2) Scotland, and (3) Ireland. The following conditions are now applicable, in addition to the usual regulations as to "owner's declaration," etc. :—

(1) No shipment may be made for one month from the date of an outbreak of foot-and-mouth disease, but the occurrence of this disease in one country does not prevent exportation from either of the others.

(2) After one month from the date of the last outbreak, cattle, sheep or swine may be shipped at London, Liverpool or Glasgow from any part of the country provided that, until three months have elapsed since the date of an outbreak, no animals may be exported which during this period have been within a radius of fifteen miles from the infected premises.

(3) Fodder accompanying live stock (including horses) must be the produce of some county where no outbreak of foot and mouth disease has occurred for six months prior to the date of shipment. The fodder must be sent direct from such county to the ship, and a sworn declaration as to its origin must be provided. This restriction applies for a period of six months following an outbreak of foot-and-mouth disease.

Export of British Live Stock to Argentina.

THE Board of Agriculture and Fisheries notify that, in accordance with the new requirements of the Argentine Government, official certificates can now be issued in respect of cattle, sheep, goats and swine which have been located during the preceding three and a half months in counties in which foot-and-mouth disease has not existed during that period. The exportation of live stock from the United Kingdom is prohibited now by Order in Council, but applications for licences to export may be made to the War Trade Department, 4, Central Buildings, Westminster, S.W.

Prices of Agricultural Produce.

PART III. of the Agricultural Statistics for 1914, dealing with the prices and supplies of corn, live stock and other agricultural produce in England and Wales, has been published by the Board (Cd. 8112, price 5*d*.). The returns now include reports on the Guildford, Northampton and Oswestry live stock markets, and on sales of store stock at Haverfordwest, while the particulars concerning prices ... marison of

the prices of 1914 with those of previous years is made by means of an agricultural index number,* and the opening report also deals with the prices obtaining during the first seven months of 1915.

London Thoroughbred Stallion Show, 1916.

THE President of the Board of Agriculture and Fisheries is now in a position to state that a Show of Thoroughbred Stallions will be held in conjunction with the Hunters' Improvement Society at the Royal Agricultural Hall on 29th February and 1st March, 1916, and that sixty King's Premiums (including twelve Super-Premiums) will be offered for award by the Board on the same conditions as obtained at the show held in March last. Full particulars of these Premiums will be issued in due course.

In addition to the King's Premiums, the Board will be prepared to consider recommendations from their County Light Horsebreeding Committees for the award of, approximately, forty Board's Premiums.

Improvement of Farming and Provision of Labour.

THE following circular letter, dated 26th November, 1915, has been issued to the Secretaries of the County War Agricultural Committees:—

SIR,—I am directed by the President of the Board of Agriculture and Fisheries to say that he hopes that one of the matters which the County and District War Agricultural Committees will consider will be whether they can take any steps to secure that land which is at present lying waste or is being badly farmed, should be brought into improved cultivation. Lord Selborne realises that nothing in the nature of large schemes of reclamation involving considerable capital expenditure is practicable under present circumstances, but he is satisfied that much could be done to increase the production of food by bringing into cultivation small areas of land which are at present producing nothing. I am to say that Lord Selborne hopes that your Committee will promote the object in view by assisting Societies and individuals to obtain such land and by providing them with expert advice to ensure its profitable cultivation.

Lord Selborne feels that one of the most important functions of the War Agricultural Committees should be to create a strong public opinion against bad farming and in favour of making the most of the land, and he hopes that your Committee will do all they can in this direction.

The scarcity of labour will make it difficult for farmers to keep their land free from weeds, and a special effort should be made to prevent occupiers of waste or poorly cultivated land from injuring the fields of their neighbours by allowing thistles, &c., to run to seed.

Steps should also be taken to prevent waste of food through the depredations of hares, rabbits, rats, sparrows, and other pests. Suggestions for destroying rats are made in the Board's Leaflet No. 244 and for reducing sparrows in Leaflet 84. The formation of "Rat and Sparrow Clubs" on the lines indicated in the latter leaflet might be recommended by the District Committees.

Labour for the Steam Ploughing Season next Spring.—With a view to considering what steps can be t [illegible]

of skilled men will be available to work machines for steam cultivating and ploughing during the coming Spring, Lord Selborne would be obliged if your Committee would obtain from the proprietors of steam tackle in your county full particulars of the men required to work the existing sets of machines and of any shortage of skilled men at the present time. Further, as it is possible that the War Office may agree to arrangements being made for the release on furlough of skilled men, who have enlisted, in order to take part in Spring cultivation, any information possessed as to the whereabouts of such men should be supplied.

A draft Form of Enquiry is enclosed* and Lord Selborne would suggest that if your Committee agree, a copy should be sent to each proprietor of steam tackle in your county. When the completed forms are returned to you, Lord Selborne would be obliged if they could be forwarded to this office together with your Committee's observations on the matter generally so far as the position in the county is concerned. The Board will be prepared to supply a sufficient number of copies of the Form for distribution in your county.

I am, &c.,

SYDNEY OLIVIER, *Secretary.*

Hardship with Respect to the Sale of Milk.

THE following circular letter, dated 29th November, 1915, has been issued to Local Authorities in England and Wales for the purposes of the Sale of Food and Drugs Acts, 1875 to 1907:—

SIR.—Th. resident of the Board of Agricu ture and Fisheries has recently had under consideration representations as to difficulties and hardship experienced by milk producers as the result of the administration by Local Authorities of the Sale of Food and Drugs Acts with respect to the sale of milk.

The Sale of Milk Regulations provide that milk which falls below the specified limits shall be presumed to be adulterated, but, though the Regulations make it necessary for a Court of law to hold, until the contrary is proved, that such milk is adulterated, it does not necessarily follow that it is in the interest of the consumer or fair to the producer that a Local Authority should direct a prosecution in every case on the mere *prima facie* evidence resulting from the analysis and the Regulations.

It is now well known that, while the average composition of the day's milk of a herd of cows is fairly constant, and is of a quality that would seldom expose producers to risk of prosecution, the variation between the composition of the morning's and the evening's milk may be considerable, particularly where the periods of milking are widely uneven, with the result that the mixed milk of a herd of cows will from time to time contain less than 3 per cent. of butter fat. In the case of an individual cow, wide variations in the quality of the milk will temporarily occur, and if such milk is not mixed, or mixed with the milk of only three or four animals, the analysis may disclose less than 3 per cent. of butter fat.

Lord Selborne suggests, therefore, that before proceedings are instituted on analytical evidence there should be a preliminary investigation by an officer of the Local Authority, or that the milk producer

* Not here printed.

should be given an opportunity of making any explanation or representation which he has to offer.

In some cases a sample of milk is taken at the farm immediately after the cows have been milked, in the presence of the officers of the Local Authority, and if the result of the analysis corresponds with that of the original sample no further action is considered necessary.

The principle of thus comparing the original sample with a sample of a corresponding milking on the farm has been adopted in the Milk and Dairies (Consolidation) Act of this session, the operation of which is at present suspended.

Lord Selborne recognises that it is not possible to adopt the same procedure in all localities, but commends the foregoing observations to the consideration of Local Authorities with a view to preventing the prosecution of innocent persons.

I am, &c.,

SYDNEY OLIVIER, *Secretary.*

THE following circular letter dated December, 1915, has been issued by the Board to Clerks of Parish Councils, to call attention to Special Leaflet No. 32 on War Food Societies:—

War Food Societies.

SIR.—I am directed by the Presiden of the Board of Agriculture and Fisheries to refer to the Circular Letter addressed to you by the Board on the 26th August, 1914, calling attention to the series of Special Leaflets which were being prepared for the guidance of allotment holders and others wishing to increase their supplies of home-grown food, and enclosing copies of the three numbers which had been issued at that date.

Further leaflets in the same series, dealing with various aspects of agriculture, with special reference to the conditions brought about by the War, have been issued from time to time throughout the year, and have been widely distributed through the agency of local bodies and otherwise. In one of the latest of the series, Special Leaflet No. 32, of which copies are enclosed herewith, the Board suggest the formation of War Food Societies for the purpose of increasing the production of food and, at the same time, of securing economy in its utilisation and consumption. It is thought that in most cases the parish will be found to be the most convenient area for the purpose in view, and Lord Selborne desires me to express the hope that he may rely on the vigorous co-operation of your Council in taking immediate steps to bring the subject to the notice of local residents and, by calling a meeting or otherwise, to press forward the formation of a society in your district.

It is believed that substantial economies can be effected in the home production and consumption of food by the organisation of co-operative efforts on the lines indicated in the leaflet; and it is hoped that advantage will be taken of the advice offered by the Board or the Agricultural Organisation Society in the establishment of local societies. The President will also be glad if your Council will assist in making known the facilities for obtaining technical advice outlined in the Special Leaflet No. 25, of which a copy is sent herewith. A list of the Board's Publications is enclosed. Copies of any leaflet required for distribution will be supplied to you post free on application.

I am, &c.,

SYDNEY OLIVIER, *Secretary.*

Produce of Potato and Root Crops in England and Wales in 1915.

PRELIMINARY Statement showing the estimated total produce and yield per acre of the potato and root crops in England and Wales in the year 1915, with comparisons for 1914, and the average yield per acre of the ten years 1905–1914.

—	Crops.	Estimated Total Produce.		Acreage.		Average Estimated Yield per acre.		Average of the Ten Years 1905-1914.
		1915.	1914.	1915.	1914.	1915.	1914.	
		Tons.	Tons.	Acres.	Acres.	Tons.	Tons.	Tons.
ENGLAND AND WALES.	Potatoes ..	2,858,123	2,953,109	463,399	461,621	6·17	6·40	6·17
	Turnips and Swedes...	11,806,542	13,450,781	929,224	1,042,438	12·71	12·90	13·13
	Mangold ..	7,834,588	7,918,767	412,509	431,366	18·99	18·36	19·43
ENGLAND	Potatoes..	2,702,181	2,807,255	436,940	436,172	6·18	6·44	6·22
	Turnips and Swedes ..	11,068 241	12,598,326	878,471	986,869	12·60	12·77	13·01
	Mangold ..	7,627,661	7,719,680	401,048	420,335	19·02	18·37	19·46
WALES.	Potatoes..	155.932	145,854	26,459	25,449	5·89	5·73	5·34
	Turnips and Swedes ..	738,301	852,455	50,753	55,569	14·55	15·34	15·24
	Mangold ..	206,927	199,087	11,461	11,031	18·05	18·05	18·01

NOTE.—The average yield of potatoes per acre in England and Wales is estimated to be exactly equal to the average of the preceding ten years; while the total production, although nearly 100,000 tons below that of last year, is some 180,000 tons above the average. Turnips and swedes have produced less than in 1914 by some 1,644,000 tons, mainly owing to the reduced acreage, although the yield per acre is also a little below that of 1914 and about $\frac{3}{5}$ ton below the average. Mangolds, also on a rather smaller acreage, have yielded some 84,000 tons less than in 1914, but the yield per acre, although about $\frac{2}{5}$ ton below average is $\frac{2}{5}$ ton above that of 1914.

Foot-and-Mouth Disease.

SINCE the 12th November, the date mentioned in the notice contained in last month's *Journal* on the subject of foot-and-mouth disease, 18 further outbreaks of the disease have been confirmed in Great Britain, up to 11th December, 17 of which were on premises in the county of Somerset, and one in Wiltshire (near Bradford-on-Avon). Of the 18 outbreaks, 3 occurred in the Bath district already scheduled in connection with the previous recent outbreaks, and in the same locality. The remaining 15 outbreaks form a separate group of cases in and around Butleigh, near Glastonbury, some 20 miles from Bath. The first of this series was confirmed on the 15th November, necessitating the issue by the Board of an Order entirely prohibiting the movement of animals over a wide area around Butleigh, adjcining the Bath Scheduled District on the north side. The 14 subsequent outbreaks in this locality were all within a radius of about 5 miles from Butleigh.

By an Order which came into operation on the 29th November, the two Scheduled Districts were amalgamated and the restrictions modified so as to permit of certain movements of stock in those parts of

the district outside four separate areas immediately surrounding the infected premises, in which areas all movement continued to be prohibited.

Later, by an Order which took effect on 6th December, 2 of these prohibited areas were merged into the zone in which the movement of stock by license was allowed, and licensed fat stock markets were permitted in that zone. At the same time the restrictions were withdrawn altogether from the outlying parts of the scheduled district, except in the Glastonbury neighbourhood. A further substantial modification was made as from 13th December by an Order which limited the area subject to restrictions in the Bath district to one of about 7-8 miles radius around the infected premises near Bradford-on-Avon, and in the Glastonbury district to an area of similar extent around Butleigh and West Pennard.

No further case having been reported from Pembrokeshire since that on the 28th October referred to in last month's *Journal*, all remaining restrictions were withdrawn from that district on the 22nd November.

Purchase of Colonel Hall Walker's Stud.

THE Government has accepted the generous offer made by Colonel W. Hall Walker, M.P., Member for the Widnes Division of Lancashire, to present his valuable stud to the Nation. It will also purchase his properties at Tully, Co. Kildare, and at Russley, Wilts, and use them in connection with the maintenance of a proper stock of Army horses in the United Kingdom.

MISCELLANEOUS NOTES.

Agricultural Index Number.*

THE Agricultural Index Number, which was compiled for the first time last year, has been continued as affording an indication of the general change in the price level of the year's produce of the farm. As explained in the Report for 1913,† the annual price of each commodity, or groups of commodities, has been calculated on the general principle of including the market quotations for that part of the year in which the particular produce is sold by farmers; and the General Index Number has been formed by averaging the particular index numbers, weighting them proportionately to the total value sold off the farm, as ascertained by the Census of Agricultural Production in 1908. Judged by this standard the average price of the produce of the farms in 1914 shows a slight fall from 1913, the index number being 111, as against 112 in each of the two previous years.

In a year in which the economic conditions were suddenly changed, as in 1914, statistics dealing with the year as a whole present a somewhat imperfect view of the facts. Prices for the first seven months of 1914 were affected by normal conditions; those for the last five months were affected by war conditions of an unprecedented character. A table is therefore given showing the course of these index numbers month by month. The movement of the General Monthly Index Number, though constructed in the same way as the Annual Index Number, is subject to a larger margin of error, since the quantities of many commodities sold during each month vary greatly according to the season, and the weights

attributable to each item ought properly to vary in every month. There are, however, in the great majority of cases, no satisfactory data upon which to base any safe estimate of the relative quantities sold at different times of the year; and thus the Monthly Index Number has, perforce, had to be calculated as if the sales of produce were spread equally over the year. It of course remains true that the index number of any particular commodity represents the movements of that commodity as compared with the base period (1906–8), although the General Index Number can only be regarded as very approximate. It may also be observed that the Annual Index Number of any commodity is liable to differ materially from the average of the twelve monthly numbers, since the former represents the price only during the season wheu the bulk of the produce is sold off the farm.

Index Numbers of Prices of the Produce sold off Farms in England and Wales in 1914.

Average Price, 1906–8 = 100.

Commodities.	1906–8.	January.	February	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year, 1914.
Cattle (25)	100	114	116	119	116	114	114	115	120	117	116	120	124	117
Milk (21)	100	121	121	121	91	91	91	91	91	91	127	127	127	109
Sheep (13)	100	116	113	116	113	106	103	106	113	110	110	113	113	110
Pigs (13)	100	127	127	126	122	113	110	106	116	118	119	117	118	118
Hay (11)	100	89	89	86	87	85	83	87	92	95	94	95	98	90
Wheat (8)	100	102	102	103	104	107	112	112	121	123	122	132	140	125
Barley (6)	100	101	102	100	100	100	98	95	108	115	111	113	115	113
Potatoes (6)	100	102	99	98	110	116	112	..	..	90	89	100	116	93
Poultry and Eggs (4)	100	117	110	106	100	103	85	89	89	91	107	118	122	103
Fruit (4)	100	102	97	..	..	..	110	95	100	68	71	71	92	92
Wool (3)	100	127	128	131	131	131	129	128	129	128	136	149	150	133
Butter (3)	100	115	111	109	101	94	90	95	107	107	111	115	119	106
Oats (2)	100	108	109	108	106	109	114	115	129	137	131	144	149	137
Hops (1)	100	207	165	181	163	151	153	145	..	104	92	89	94	95
Cheese (1)	100	110	110	111	111	111	104	101	112	107	109	111	114	109
Beans and Peas (1)	100	104	101	102	101	100	108	120	121	121	117	129	143	114
Vegetables (1) ..	100	152	146	139	..	..	..	..	145	115	121	121	126	134
General Index Number	100	113	113	114	107	105	104	103	109	107	113	116	120	111

The chief point indicated by the table is that prices of farm produce were falling steadily during spring and summer, until the outbreak of war checked the fall, causing an immediate rise, as between July and August, of somewhere about 6 per cent. After a slight relapse in September, prices continued to rise, and in December were approximately 20 per cent. above the standard of 1906–8.

It has been found possible to carry the Monthly Index Number forward, so as to comprise the first 12 months of the war. The prices realised by farmers for their produce month by month, as compared with the average prices of the three years 1906–8, appear as follows:—

August, 1914	109	February, 1915	131
September, "	107	March "	135
October, "	113	April, "	136
November, "	116	May, "	140
December, "	120	June, "	140
January, 1915	125	July, "	138

For the reasons given above these numbers give only an imperfect measure of the effect of the rise of prices on British farm produce, but they may be regarded as not unfairly representing the broad facts for farming as a whole. Their application to particular classes of farming

differs considerably. The three groups of corn-growing, meat-production, and dairying, show very different results. The course of prices during the first 12 months of war was as follows:—

—	Wheat.	Barley.	Oats.	Cattle.	Sheep.	Wool.	Milk.	Butter.	Cheese.
1914.									
August ..	121	108	129	120	113	129	91	107	112
September	123	115	137	117	110	128	91	107	107
October ..	122	111	131	116	110	136	127	111	109
November	132	113	144	120	113	149	127	115	111
December	140	115	149	124	113	150	127	119	114
1915.									
January ...	160	118	161	131	116	154	127	123	116
February .	181	133	180	136	119	168	127	127	125
March ..	179	127	179	138	132	182	127	123	136
April ..	182	121	177	144	132	193	118	117	142
May ..	200	130	187	158	135	183	115	109	144
June ..	189	133	186	166	126	185	115	107	143
July ..	172	137	182	169	126	190	115	115	136

In the case of wheat and oats it must be noted that prices were before the war in the one case 12, and in the other 15 per cent. above the average, while for all three crops the main rise occurred after the larger proportion of them had been sold off the farm.

The price of wool affects the grower but slightly, except during the summer months, but cattle and sheep are marketed by farmers more or less in every month.

The value of cheese as an item in the total receipts of farmers is comparatively insignificant, and that of butter is also small in relation to the main products. Milk, however, is, next to cattle, the largest item in the account of British agriculture. The modest rise in price of milk and butter, as compared with that of other farm produce, shows unmistakably that dairy farmers on the whole gained less than those who relied on corn and meat for their revenue.

It is hardly necessary to point out that while these figures give a general indication of increased receipts by farmers for their produce, they afford no guide to the profits made by them, which would necessarily depend upon the extent to which their outgoings for labour, feeding stuffs, fertilisers, and other commodities have increased. For a profit and loss account the data are not available, but it is evident that the turnover of British agriculture during the war was substantially greater than the average, and was probably greater than in any recent year.

Cultivation of Medicinal Plants in Canada.*

Considerable interest has recently been taken in Canada in the cultivation of certain drug plants which formerly grew wild in sufficient quantity but which, owing to extensive collection, have become somewhat scarce. The Canadian Department of Agriculture have, therefore, published a bulletin on the subject, giving information as to the commercial prospects of the industry and the habits and methods of cultivation of suitable species.

* An article on "The Cultivation and Collection of Medicinal Plants in England," appeared in this *Journal* for September, 1914, p. 492.

While the advice contained in the bulletin is essentially based on Canadian conditions of soil and climate, certain of the broader recommendations might well prove useful for growers in this country.

It is stated that prospective growers of drug plants must be careful to ascertain exactly the species of plant needed by the manufacturers. Especially in cases where the stock is obtained by digging up wild species, the grower should compare his plants with descriptions and illustrations in reliable publications, and if at all uncertain should seek the advice of a botanist. Growers should make a point of ascertaining the exact part of the plant used in the preparation of medicine, as the inclusion of other parts than that prescribed by the manufacturers would lower the selling price of the produce.

Roots of annual plants should be dug just before the flowering period, those of biennial plants in the autumn of the first year, and those of perennial plants in the autumn of the second or later years of their growth. In some cases the collection may be made very early in spring before growth begins. Underground stems or rhizomes should be collected at the same time of year as perennial roots.

Barks may be collected in winter, or during the spring, when the sap begins to flow and when it is easier to detach the bark.

Leaves should, as a rule, be collected when the plant is in flower, and only the healthy green leaves should be chosen. Where the whole green plant or herb is used the older thick stems should be rejected, and only the younger branches, flowers, and leaves taken.

Flowers should be collected just after they are open, and before they begin to wither. With certain exceptions, fruits are gathered when fully ripe. Seeds should be collected when ripe and just before the seed vessels split or open. In the case of some plants that have numerous small seeds ripening in succession, such as caraway, a branch should be cut as soon as the majority of the seeds on it are ripe.

Most drugs are purchased by the dealers in a dried condition, and the process of drying must be carefully attended to. In warm, dry weather the plants may be spread out in thin layers in the open air, but they should not be exposed to direct sunlight, and should be put under cover at night as a protection against rain and dew; they may also be spread on the clean floor of a barn, being turned frequently. In the autumn and during rainy weather, the plants will require to be dried by artificial heat in a special drying shed with shelves, or in a greenhouse. Large roots may be sliced lengthwise before drying.

Three weeks or longer will be necessary for drying some species, according to the weather conditions and the time of year. The plants should be dried in such a way as to retain, as far as possible, their natural colours. When thoroughly dry they will usually break quite readily. Unless the drying is carefully and thoroughly done, the whole crop may be ruined by the growth of various moulds.

Before collecting drug plants, a sample should be sent to the buyer, giving the name of the plant or drug, and ascertaining what quantity will be purchased and the price offered. If the market is bad, perennial herbs and shrubs can be left in the ground until the following season; but annuals and biennials which cannot be held over must be disposed of even if the price should not be quite satisfactory. (*Canadian Dept. of Agric., Div. of Botany, Bull. No.* 23, *Second Series: Medicinal Plants and their Cultivation in Canada.*)

Importation into Argentina of Lucerne Seed and Seed of Forage Plants.

A Decree of 5th July prohibits the importation into Argentina of alfalfa seed and seed of other forage plants which contain more than 10 grains of dodder per kilogramme, or which possess a germinating value of less than 60 per cent. (according to analysis which must be made by the Directorate General of Agriculture). The ports of importation for these kinds of seed are Buenos Aires, Rosario, and Bahia Blanca. For the purpose of certificates of analysis and sale of alfalfa seed a margin of 20 grains of "large dodder" per kilogramme is fixed. Various margins are fixed for guarantees of purity and germinating value of alfalfa seed. Alfalfa seed, which does not satisfy the standards necessary for importation may be cleaned and fanned at the expense of the importer at the port of Buenos Aires.

The importation of *Medicago denticulata* or *maculata* and *M. lupulina* is prohibited.

The Decree comes into force on 5th January, 1916.

An Act was passed on 2nd June, 1915, laying down the conditions governing the sale of fertilisers and feeding stuffs in Guernsey.

Prevention of Fraud in the Sale of Fertilisers and Feeding Stuffs in Guernsey.

The vendor of a fertiliser or feeding stuff must, if the quantity sold is 100 lb. or over, furnish an invoice which must state: in the case of a fertiliser, the percentage content of nitrogen, soluble and insoluble phosphates, and potash; and in the case of a feeding stuff, whether it is composed of one, or more than one, ingredient or seed, and, in cases where it has been artificially treated other than by having been mixed, broken, ground, or chopped, the percentage content of oil and albuminoids. The invoice constitutes a guarantee of the facts so stated, certain limits of error being allowed in the case of the above percentage contents figures. With quantities of less than 100 lb. a declaration of the details required in the invoice must be exhibited in a conspicuous position.

Secondly, where the name of the feeding stuff indicates that it is composed of a particular ingredient or of two or more ingredients, and there is no indication that any other ingredient or seed has been mixed, there is held to be a guarantee that the article is composed only of the ingredients or seeds stated.

Thirdly, there is held to be a guarantee that the fertiliser or feeding stuff sold is suitable for use as such.

Besides these legally necessary invoice statements, any further statements made by the vendor as to the content of chemical or nutritive ingredients, as the case may be, in the invoice, contract of sale, letters, memorandum, circular or other advertisement are held to constitute a guarantee.

Regulations are made as to sampling by the purchaser or by the Official Analyst, and submission of samples by the purchaser to the Official Analyst.

Fines are imposed if no invoice, or a false invoice, is furnished, and for the inclusion of deleterious or worthless ingredients in feeding stuffs.

Notes on Crop Prospects and Live Stock Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for November, 1915, issued by the International Institute of Agriculture, contains estimates of the production of cereal crops in the Northern Hemisphere. The countries for which it is possible to give approximate estimates are as follows:—In *Europe*—Hungary, Denmark, Spain, France, Great Britain, Ireland, Italy, Luxemburg, Norway, Netherlands, Rumania, Russia in Europe (54 Governments), Switzerland; in *America*—Canada, United States; in *Asia*—India, Japan, Russia in Asia (10 Governments in 1915 and 9 Governments in 1914); in *Africa*—Egypt, Tunis.

Wheat.—The total production in the aforementioned countries is estimated to amount to 451,051,000 qr. in 1914–15, against 372,052,000 qr. in 1913–14, the increase being equal to 21·2 per cent., while the area sown was greater by 6·8 per cent.

Rye.—In the above-named countries, with the exception of Great Britain, India, Japan, Egypt, and Tunis, the production is calculated to total 137,129,000 qr. this year, against 119,503,000 qr. last year, or an increase of 14·7 per cent., while the area under cultivation was smaller by 0·4 per cent.

Barley.—The total production in the above countries, excluding India, is placed at 145,798,000 qr. in 1914–15, as compared with 125,260,000 qr. in 1913–14, or an increase of 16·5 per cent., but the area sown showed a decrease of 1·2 per cent.

Oats.—For the specified countries, excluding India, Japan, and Egypt, the production is estimated at 396,299,000 qr. this year, or an increase of 23·2 per cent. compared with last year, when the production amounted to 321,733,000 qr. The area sown was greater by 1·1 per cent.

Maize.—In Hungary, Italy, Rumania, Russia in Europe (54 Governments), Switzerland, Canada, United States, Japan, and Russia in Asia (10 Governments in 1915 and 9 Governments in 1914), the total production is estimated at 419,060,000 qr. this year, against 368,397,000 qr. last year, or an increase of 13·8 per cent., the area under cultivation being greater by 5·8 per cent.

In the Southern Hemisphere, the production of wheat in *Australia* is estimated at 17,870,000 qr. in 1915–16, against 3,114,000 qr. in 1914–15.

Russia.—The Central Statistical Committee has published preliminary estimates of the production of winter grain crops in 57 governments and Provinces in 1915 as follows:—Wheat 126,390,000 cwt., as compared with 94,128,000 cwt. in 1914; rye 443,646,000 cwt., against 355,411,000 cwt.; and barley 3,490,000 cwt. against 3,229,000 cwt. in 1914. (*London Grain, Seed and Oil Reporter*, 7th December.)

According to information of the Central Statistical Committee, the condition of the winter cereals up to 14th October, in 61 Governments for which fairly accurate data was received, was extremely favourable. In only one Government the crops appear to be somewhat below average, whilst in the remaining 60 Governments or Provinces the conditions of the sowings were average or over average, the crops being considerably over average or nearly good in 32 Governments. (*Broomhall's Corn Trade News*, 25th November.)

France.—The report of the Ministry of Agriculture on the condition of the winter crops on 1st November, says that wheat is estimated at 73, rye 72, barley 72, and oats 70. (100 = very good, 80 good, 60 fairly good, 50 passable.)

Canada.—The High Commissioner for Canada was informed by the Minister of the Interior at Ottawa, on the 19th November, that the area sown with autumn wheat in Canada was estimated at 1,100,000 acres, and that 53 per cent. of the area intended for next year's crop was ploughed by 31st October.

Argentina.—According to revised estimates issued by the Ministry of Agriculture, the areas sown with wheat, oats and linseed for the 1915–16 crops, are as follows: Wheat, 16,420,000 acres as compared with 15,464,000 acres in 1914; oats, 2,565,000 acres against 2,865,000 acres; and linseed, 4,000,000 acres against 4,255,000 acres in the previous year. (*London Grain, Seed and Oil Reporter*, 24th November.)

South Africa.—According to an official crop report of 20th October, this year's crop of wheat in the Union is expected to be somewhat below that of last year. In the Transvaal and the South-western district of the Cape, considerably larger crops than last year are expected, but these are more than counterbalanced by poorer yields in the Orange River Colony and in the Karroo, Border and North-eastern districts of the Cape. An increase in the yield of oats is expected, but less barley will be produced as compared with last year. (*Broomhall's Corn Trade News*, 4th December.)

Live Stock in India (Native States).—The numbers of live stock in 1913–14 are as follows (the corresponding numbers for 1912–13 being shown in brackets):—Bulls and bullocks 3,948,912 (3,924,387); cows 4,391,217 (4,247,839); bull buffaloes 245,696 (268,901); cow buffaloes 1,519,487 (1,465,877); young stock (calves and buffalo calves) 3,896,289 (3,852,236); sheep and goats 8,306,616 (8,141,110); horses and ponies 175,499 (169,336); mules and donkeys 181,121 (177,053). (*Bulletin of Agricultural and Commercial Statistics*, November, 1915.)

Live Stock in Tunis.—According to the General Census at 31st July, 1915, the numbers of live stock were as follows:—Horses 38,000 against 37,416 on the 31st December, 1913; mules 30,250 against 22,547; asses 86,240 against 95,440; cattle 269,152 against 217,304; sheep 1,119,310 against 728,540; goats 499,164 against 505,417; pigs 12,255 against 17,399. (*Bulletin of Agricultural and Commercial Statistics*, November, 1915.)

Agricultural Conditions in England and Wales on 1st December.

THE Crop Reporters of the Board, in reporting on the crops and the agricultural conditions in England and Wales on the 1st December, state that good progress was generally made in the fields during the first half of November, but that the frosts in the latter half of the month delayed operations a good deal. On the whole, autumn cultivation is perhaps rather backward for the time of year, especially in many parts of the north. It is reported that about 70 per cent. of the total area intended for wheat has already been seeded, which is somewhat less than usual. It is also estimated that the total area actually sown now is rather more than 5 per cent. below that sown at the same period of 1914; but at that date nearly four-fifths of the probable area had already been got in. The earliest-sown wheat is showing above ground, and generally appears quite satisfactory: the same comment applies in the case of winter oats and beans.

Roots are generally small in size, but are nearly everywhere sound and of good quality, except where mangolds had been left in the ground

until they were caught by the frosts at the end of the month. Cases of this are reported from all parts of the country, and such fields are probably much damaged. The total production of mangolds, from a rather smaller acreage than last year, is estimated to amount to 7,834,588 tons, or about 84,000 tons less than in 1914: the yield per acre, 18·99 tons, is about two-fifths of a ton below the average, but some two-thirds of a ton above 1914. Turnips and swedes, mainly owing to the reduced acreage, have produced only 11,806,542 tons as compared with 13,450,781 tons in 1914: the yield per acre amounted to 12·71 tons, which was rather below average. The yield of potatoes per acre is estimated to be exactly equal to the average of the past ten years, and the total production is 2,858,113 tons, about 180,000 tons more than the average, although some 100,000 tons less than the abundant crop of 1914.

Live stock have generally done fairly well during November, but the cold weather caused farmers to draw rather largely on their supplies of winter food, and prospects are that winter keep will not be very abundant in most parts of the country.

Agricultural Labour in England and Wales during November.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st December, labour was very scarce, nearly everywhere, during November; and temporary labour, especially, was extremely difficult to obtain. Wages at Martinmas hirings showed an upward tendency.

The following local summaries give further details regarding agricultural labour in the different districts of England and Wales:—

Northumberland, Durham, Cumberland and Westmorland.—The supply of labour was very deficient. At the Martinmas hirings held during November very few men were seeking places, and farmers were often short-handed for the winter. Wages were extremely high.

Lancashire and Cheshire.—The supply of labour was sufficient for present requirements in one or two districts, but generally the supply was short and wages were rising.

Yorkshire.—The deficiency in the supply of labour became greater, all classes of workers being scarce. Wages were very high.

Shropshire and Stafford.—There was a great deficiency in the supply of labour in this division, temporary hands for turnip lifting being almost unobtainable.

Derby, Nottingham, Leicester, and Rutland.—The supply of labour continued to be very short, and the position as regards skilled men appeared to be getting less favourable, although wages were rising.

Lincoln and Norfolk.—In Lincolnshire the supply of labour was variable; in some districts there was a shortage, whilst others reported that there was just sufficient for present purposes. In Norfolk labour was scarce and the shortage is likely to be felt as time goes on.

Suffolk, Cambridge, and Huntingdon.—The supply of labour was deficient throughout the division, and farmers were experiencing increased difficulty in finding workers. Root lifting was delayed by the shortage. In some parts of Suffolk wages had been increased by 1*s.* per week during November.

Bedford, Northampton, and Warwick.—Labour was everywhere reported to be deficient, both skilled and casual. The shortage appeared to be most pronounced in Bedfordshire.

Buckingham, Oxford, and Berkshire.—Labour was generally deficient and casual labour was practically unobtainable. In central Buckinghamshire stockmen were doing most of the work, and wages were higher than they have ever been for the winter months.

Worcester, Hereford, and Gloucester.—There was a general shortage of labour, and casual labour was scarce. Women were helping to pull mangolds in many places.

Cornwall, Devon, and Somerset.—Labour was still deficient and will probably be scarcer as time goes on.

Dorset, Wiltshire, and Hampshire.—The shortage of labour was increasingly marked, and temporary hands were almost unobtainable.

Surrey, Kent, and Sussex.—The supply of labour continued to decrease, and it was very deficient in most districts. The scarcity of workers seems to be most felt on dairy farms,

Essex, Hertford and Middlesex.—The shortage was being increasingly felt and in many districts was becoming a serious question.

North Wales.—Labour was scarce, but it was not much felt lately as little work was possible. With more open weather a shortage of labour for turnip lifting was expected.

Mid-Wales.—Labour was very deficient in Montgomery, Radnor and Brecon. In Cardigan the supply seemed sufficient for present requirements, but some apprehension was felt as to the effect of later developments.

South Wales.—Labour was generally deficient, with few exceptions, while a substantial advance in wages was reported in east Carmarthen.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st December, 1915, certain diseases of animals existed in the countries specified :—

Austria (on the 3rd Nov.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (month of Oct.).
Anthrax, Foot-and-Mouth Disease (212 outbreaks), Swine Erysipelas, Swine Fever.

France (for the period 17th Oct.—6th Nov.).
Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Swine Fever.

Germany (for the period 15th—31st Oct.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (month of Oct.).
Anthrax, Foot-and-Mouth Disease (237 outbreaks), Foot-rot, Swine Erysipelas.

Hungary (on the 3rd Nov.).
Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox, Swine Erysipelas, Swine Fever.

Italy (for the period 8th—14th Nov.).
Anthrax, Blackleg, Foot-and-Mouth Disease (2,616 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosis.

Norway (month of Oct.).
Anthrax, Blackleg, Swine Fever.

Rumania (for the period 29th Oct.—5th Nov.).
Anthrax, Foot-and-Mouth Disease, Rabies, Sheep-pox, Swine Fever.

Russia (*month of June*).

Anthrax, Foot-and-Mouth Disease (397,356 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (*month of Aug.*).

Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (*month of Oct.*).

Anthrax, Blackleg, Swine Erysipelas, Swine Fever.

Switzerland (*for the period 8th—14th Nov.*).

Anthrax, Blackleg, Foot-and-Mouth Disease (17 "étables" entailing 197 animals, of which 13 "étables" were declared infected during the period), Swine Fever.

No further returns have been received in respect of the following countries :—Belgium, Bulgaria, Montenegro, Serbia.

The Weather in England during November.

District.	Temperature.		Rainfall.				Bright Sunshine.	
	Daily Mean.	Diff. from Average.	Amount.		Diff. from Average.	No. of Days with Rain.	Daily Mean.	Diff. from Average.
Week ending Nov. 6th :	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours
England, N.E. ...	41·6	—4·0	0·54	14	— 3	5	2·3	0·0
England, E.	43·8	—2·5	0·71	18	+ 4	5	2·0	—0·8
Midland Counties ...	40·4	—5·0	0·47	12	— 5	2	2·7	+0·5
England, S.E.... ...	43·6	—4·4	0·99	25	+ 4	3	3·0	+0·4
England, N.W. ...	40·9	—5·7	0·08	2	—21	2	3·7	+1·6
England, S.W. ...	42·7	—5·5	0·66	17	—11	2	4·7	+2·2
English Channel ...	48·7	—2·9	1·15	29	+ 5	4	3·9	+0·9
Week ending Nov. 13th .								
England, N.E.... ...	42·4	—2·2	0·92	23	+ 8	4	2·9	+0·9
England, E.	43·3	—1·8	1·63	41	+28	4	1·9	—0·5
Midland Counties ...	42·3	—2·0	1·89	48	+32	5	2·3	+0·3
England, S.E.... ...	44·4	—2·5	1·64	42	+22	4	2·2	—0·1
England, N.W. ...	43·4	—2·3	1·61	41	+19	5	2·1	+0·3
England, S.W. ...	44·7	—2·7	2·15	55	+28	6	1·6	—0·6
English Channel ...	49·0	—1·8	1·95	49	+24	7	2·5	—0·2
Week ending Nov. 20th :								
England, N.E. ...	35·8	—7·4	0·20	5	— 9	3	2·8	+0·9
England, E.	36·7	—6·7	0·35	9	— 4	4	4·2	+2·1
Midland Counties ...	34·7	—8·0	0·19	5	— 9	2	3·5	+1·7
England, S.E	36·1	—9·1	0·23	6	—11	2	4·4	+2·4
England, N.W. ...	34·0	—10·2	0·28	7	—13	2	4·2	+2·5
England, S.W. ...	36·8	—9·2	0·15	4	—20	2	4·4	+2·3
English Channel ...	42·7	—6·9	0·44	11	—12	3	3·1	+0·6
Week ending Nov. 27th :								
England, N.E. ...	36·2	—5·8	0·16	4	— 9	2	1·6	—0·2
England, E.	37·0	—4·8	0·20	5	— 7	3	1·8	0·0
Midland Counties ...	34·3	—7·1	0·01	0	—13	1	1·3	—0·3
England, S.E.... ...	36·1	—7·5	0·01	0	—15	1	2·3	+0·5
England, N.W. ...	33·8	—9·2	0·09	2	—18	1	2·5	+1·0
England, S.W. ...	35·8	—8·8	0·04	1	—21	1	2·8	+0·9
English Channel ...	42·7	—5·6	0·07	2	—18	1	1·3	—0·9

* 1 inch = 25·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	NOVEMBER.		ELEVEN MONTHS ENDED NOVEMBER.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	51	44	528	664
Animals attacked	52	46	595	725
Foot-and-Mouth Disease:—				
Outbreaks	28	—	49	24
Animals attacked	556	—	671	124
Glanders (including Farcy):—				
Outbreaks	6	5	47	91
Animals attacked	8	10	82	275
Parasitic Mange:—				
Outbreaks	68	†—	*770	†1,530
Animals attacked	147	†—	*1,656	†2,642
Sheep-Scab:—				
Outbreaks	22	29	188	188
Swine Fever:—				
Outbreaks	264	374	3,714	4,056
Swine Slaughtered as diseased or exposed to infection ...	951	2,260	15,888	37,768

* Figures for eight months only. † The Parasitic Mange Order of 1911 was suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	NOVEMBER.		ELEVEN MONTHS ENDED NOVEMBER.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	1	—	2	1
Animals attacked	1	—	2	1
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	76
Animals attacked	—	—	—	957
Glanders (including Farcy):—				
Outbreaks	—		1	—
Animals attacked	—	—	3	—
Parasitic Mange:—				
Outbreaks	4	3	68	74
Sheep-Scab:—				
Outbreaks	32	20	378	454
Swine Fever:—				
Outbreaks	17	7	236	185
Swine Slaughtered as diseased or exposed to infection ...	54	39	1,310	919

Unit Prices of Artificial Manures. Statement of cost to the purchaser of 1 per cent. per ton of Nitrogen, Soluble and Insoluble Phosphates, and Potash derived from

	London.	King's Lynn.	Hull.	Newcastle.
	s. d.	*s. d.*	*s. d.*	*s. d.*
Nitrogen from:				
*Sulphate of Ammonia pure ... 95%	15 4½	—	15 6	—
93%	—	—	10 7	—
Calcium Cyanamide ...	—	—	14 0½	13 1
Nitrate of Soda pure 95%	—	—	20 0	—
90%	20 0	—	20 8	—
Nitrate of Lime ...	—	—	—	—
Soluble Phosphates from:				
Superphosphate 35%	2 8	—	2 6½	2 9
,, 33%	2 8	—	2 7	2 10
,, 30%	2 9	—	2 8½	3 0
,, 26%	3 0	—	2 10½	3 3
Dissolved Bones	3 11½	—	3 9	4 2½
Allowed for Nitrogen	*20 8*	—	*19 7*	*21 11½*
Allowed for Insol. Phos.	*2 1*	—	*2 0*	*2 2½*
Insoluble Phosphates (Citric Soluble) from:				
Basic Slag	2 3	—	1 10½	—
Insoluble Phosphates from:				
Basic Slag	—	—	—	—
Bone Meal	1 10	—	1 8½	1 9½
Allowed for Nitrogen	*18 1½*	—	*17 0½*	*17 6*
Steamed Bone Flour ...	1 10	—	1 11	1 9
Allowed for Nitrogen	*17 10½*	—	*18 8½*	*17 4*
Potash from:				
Kainit	—	—	—	—
Sulphate of Potash ...	—	—	—	—
Muriate of Potash ...	—	—	—	—
Potash Salts	—	—	—	—

NOTE.—These unit prices are based on the *probable* retail cash prices in bags f.o.r. for quantities of not less than 2 tons of the manures mentioned at the ports and places specified, but it should be borne in mind that market prices are fluctuating considerably at the present time. The prices are published by the Board of Agriculture and Fisheries for use in comparing the commercial values of artificial manures. They may also be used as a guide to the probable price per ton of any of the manures mentioned if the unit prices of the constituents of the

* By a special arrangement made with the Sulphate of Ammonia Association, farmers will be able to purchase a certain amount of sulphate of ammonia from manufacturers for £14 10*s.* per ton, in bags, net cash, delivered in lots of not less than 10 cwt., f.o.r. at the makers' works. These terms apply to sales of a quantity

various sources, at certain ports and Manufacturing Centres, for December, 1915.

Silloth.	Liverpool.	Widnes.	Newport.	Bristol.	Plymouth.
s. *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*
—	—	16 3	15 6	—	—
—	16 5	16 5½	—	16 6	16 2½
—	—	—	—	—	—
—	18 11	19 0½	—	19 4½	18 10½
—	19 0	—	20 1	19 11	19 6
—	—	—	—	—	—
—	2 8½	2 7½	2 7	2 9½	2 9½
—	2 9½	2 8½	2 8	2 10	2 10
—	2 10½	2 9½	2 9	2 10	2 10½
—	3 2	3 1	3 0½	3 2	3 2
—	4 4	4 4	3 11½	4 2½	4 2½
—	*22 8*	*22 7½*	*20 8½*	*21 10*	*21 10*
—	2 3½	2 3½	2 1	2 2½	2 2½
—	—	—	—	2 1½	2 7½
—	—	—	—	—	—
—	1 10	1 9½	1 7	1 9	1 11
—	*17 11½*	*18 0½*	*15 6½*	*16 11½*	*18 9*
—	1 9½	—	1 7	1 11	—
—	*17 7½*	—	*15 8½*	*19 1*	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—

manure are multiplied by the percentages of the constituents found in it, and due allowance is made for the difference between cash prices and credit prices, and for cost of carriage from the nearest centre to the place where it is delivered to the purchaser. If used in connection with the valuation of a compound manure regard must be had to the sources of the constituents, and a reasonable sum must be added for mixing, disintegrating and rebagging the ingredients, bags, and loss of weight.

reserved for autumn use, and hold during November and December, so long as the reserved quantity remains unsold. The price stated is for sulphate of ammonia containing 20·16 N. The unit price, therefore, works out at **14*s*. 4½*d*.**

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in November and October, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	November. First Quality.	November. Second Quality.	October. First Quality.	October. Second Quality.
FAT STOCK:—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle:—	s. d.	s. d.	s. d.	s. d.
Polled Scots	10 11	10 10	11 4	10 8
Herefords	11 3	10 1	11 10	10 9
Shorthorns	11 3	10 2	11 8	10 7
Devons	11 5	10 3	11 11	10 5
Welsh Runts	10 10	10 2	11 6	10 8
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	10	8¾	10½	9¼
Sheep:—				
Downs	10¾	9½	10¾	9¾
Longwools	10	9	10	9
Cheviots	11	10¼	11	9¾
Blackfaced	10¾	9¼	10	9
Welsh	10	8½	9	8¾
Cross-breds	10½	9½	10¾	9½
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs:—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	10 6	9 10	10 6	9 10
Porkers	11 3	10 8	11 3	10 7
LEAN STOCK:—	per head.	per head.	per head.	per head.
Milking Cows:—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	28 18	23 19	27 15	22 15
,, —Calvers ...	28 0	22 19	26 13	22 1
Other Breeds—In Milk ...	26 9	21 7	25 19	20 6
,, —Calvers ...	21 0	19 10	21 10	19 15
Calves for Rearing	2 18	2 5	3 1	2 6
Store Cattle:—				
Shorthorns—Yearlings ...	12 19	10 19	13 2	11 3
,, —Two-year-olds...	17 15	15 11	18 7	16 7
,, —Three-year-olds	23 4	19 8	24 5	20 9
Herefords —Two-year-olds...	18 19	16 16	20 16	16 15
Devons— ,,	17 16	15 12	18 10	15 6
Welsh Runts— ,,	18 10	16 10	19 10	16 19
Store Sheep:—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	47 4	41 10	48 3	40 3
Store Pigs:—				
8 to 12 weeks old	26 2	19 8	28 1	22 0
12 to 16 weeks old	46 5	35 4	45 11	35 8

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in November, 1915.

(*Compiled from Reports received from the Board's Market Reporters.*)

Description.	Quality.	Birmingham.	Leeds.	Liverpool.	London.	Manchester.
		per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.
BEEF:—						
English	1st	71 0	72 6	—	72 0	69 6
	2nd	66 6	67 6	—	67 6	66 6
Cow and Bull	1st	64 0	65 6	59 0	63 0	61 0
	2nd	58 6	60 6	53 6	58 6	56 0
Irish: Port Killed	1st	65 6	68 0	68 0	70 0	67 6
	2nd	58 6	65 6	63 6	65 6	64 6
Argentine Frozen—						
Hind Quarters	1st	66 6	65 6	—	—	—
Fore ,, ...	1st	56 6	56 0	—	—	—
Argentine Chilled—						
Hind Quarters	1st	73 0	70 6	71 0	72 0	71 0
Fore ,, ...	1st	57 6	57 6	56 0	56 0	56 0
Australian Frozen—						
Hind Quarters	1st	64 0	66 0	62 0	—	62 0
Fore ,, ...	1st	54 6	58 6	56 0	—	56 0
VEAL:—						
British	1st	84 0	—	—	100 6	—
	2nd	79 6	—	—	88 6	—
Foreign...	1st	—	—	—	107 6	—
MUTTON:—						
Scotch	1st	86 6	—	91 6	88 0	91 6
	2nd	84 0	—	87 0	83 6	89 0
English...	1st	86 6	88 6	—	83 6	88 6
	2nd	83 0	84 0	—	78 6	84 0
Irish: Port Killed	1st	84 0	—	87 6	80 6	84 0
	2nd	—	—	82 0	76 0	81 6
Argentine Frozen	1st	59 0	59 6	57 6	63 0	57 6
Australian ,, ...	1st	55 6	56 6	53 6	53 6	53 6
New Zealand ,, ...	1st	60 6	—	—	69 0	—
LAMB:—						
British	1st	—	—	—	—	—
	2nd	—	—	—	—	—
New Zealand	1st	78 6	77 0	76 0	75 0	76 0
Australian	1st	70 6	—	66 0	67 0	66 0
Argentine	1st	69 6	—	66 6	68 0	66 6
PORK:—						
British	1st	98 0	91 0	102 6	98 0	99 0
	2nd	91 6	88 0	95 6	88 6	93 6
Frozen	1st	77 6	74 6	76 0	77 0	—

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in November, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Bristol.		Liverpool.		London.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	19 0	17 0	—	—	19 0	18 0
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	157 0	151 6	158 0	153 0	158 6	152 0
" Factory	134 0	128 0	133 6	127 0	135 6	127 0
Danish...	—	—	173 0	168 0	171 0	166 0
French...	—	—	—	—	154 0	148 0
Russian	137 6	129 6	—	130 6	133 0	125 6
Australian	—	—	—	—	164 0	160 0
New Zealand	—	—	—	—	164 0	160 0
Argentine	—	—	—	—	156 6	153 6
CHEESE:—						
British—						
Cheddar	97 6	88 6	94 6	92 6	99 0	92 6
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	104 6	101 0	108 0	101 6
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	87 6	85 0	89 0	85 6	87 6	84 0
BACON:—						
Irish (Green)	107 0	104 0	105 0	99 6	105 0	101 6
Canadian (Green sides)	94 6	90 0	94 6	91 6	95 0	90 0
HAMS:—						
York (Dried or Smoked)	141 6	136 0	—	—	148 0	140 0
Irish (Dried or Smoked)	—	—	—	—	141 0	135 0
American (Green) (long cut)	90 0	86 0	90 0	86 0	95 0	91 6
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British...	22 1	—	—	—	25 7	23 11
Irish	22 1	19 0	21 11	20 4	24 0	22 0
Danish...	—	—	—	—	24 6	22 6
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
British Queen ...	96 0	81 0	—	—	101 0	91 0
Edward VII.	101 6	88 6	78 6	73 6	96 6	88 6
Up-to-date	97 0	85 0	75 0	71 6	97 6	90 6
HAY:—						
Clover	—	—	170 0	130 0	131 0	122 0
Meadow	—	—	—	—	128 0	119 0

AVERAGE PRICES of British Corn per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	Wheat.						Barley.						Oats.					
	1913.		1914.		1915.		1913.		1914.		1915.		1913.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Jan. 2...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
,, 9...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
,, 16...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
,, 23...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
,, 30...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
,, 13...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
,, 20...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
,, 27...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
,, 13...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
,, 20...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
,, 27...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3...	31	4	31	6	54	6	27	0	25	6	31	9	19	2	18	5	30	6
,, 10...	31	3	31	5	54	9	27	8	26	8	31	3	19	2	18	4	30	4
,, 17...	31	6	31	7	55	4	26	11	25	4	30	10	18	10	18	4	30	5
,, 24...	31	8	31	9	56	5	26	7	26	6	31	5	19	3	18	5	30	11
May 1...	32	2	31	9	58	3	25	11	26	0	32	7	19	6	18	5	31	5
,, 8...	32	6	32	2	60	5	25	9	25	6	33	3	19	6	18	9	32	4
,, 15...	32	10	32	7	61	7	25	4	26	3	34	0	19	9	18	11	32	5
,, 22...	32	10	33	0	62	0	25	3	25	10	34	1	19	11	19	0	32	8
,, 29...	32	7	33	9	61	11	26	1	26	1	34	8	20	1	19	4	32	7
June 5...	32	10	34	0	61	9	26	2	25	11	35	4	19	8	19	4	32	5
,, 12...	32	8	34	1	60	1	24	7	24	11	34	5	20	2	19	8	32	4
,, 19...	32	8	34	1	56	1	23	10	25	10	34	3	19	8	19	9	31	9
,, 26...	32	8	34	3	52	0	24	3	25	4	34	4	19	1	20	0	31	9
July 3...	33	1	34	4	49	5	25	2	24	6	35	3	21	0	19	9	31	1
,, 10...	33	4	34	2	50	1	25	10	24	9	34	7	19	4	20	0	31	6
,, 17...	33	6	34	1	52	7	24	9	24	2	35	8	20	5	19	10	31	6
,, 24...	33	10	34	0	53	10	24	1	24	7	35	10	20	8	19	9	32	1
,, 31...	34	1	34	2	55	3	24	5	25	9	36	1	20	3	19	8	31	1
Aug. 7...	34	1	34	9	55	4	24	9	25	2	35	7	19	0	19	1	31	5
,, 14...	34	3	40	3	55	2	24	7	29	4	37	0	18	7	25	1	31	7
,, 21...	33	7	38	9	54	3	26	5	29	10	39	4	18	8	24	3	31	4
,, 28...	32	7	36	2	51	11	29	0	30	3	38	3	17	10	23	5	30	0
Sept. 4...	31	11	36	5	45	3	30	11	30	6	38	1	17	8	23	9	26	10
,, 11...	31	9	37	10	43	0	31	5	29	11	37	11	18	0	23	11	26	8
,, 18...	31	7	38	3	42	9	30	9	29	5	39	0	17	11	23	8	26	4
,, 25...	31	6	37	6	43	3	30	1	29	3	39	8	17	9	23	3	26	1
Oct. 2...	31	3	37	1	43	5	29	9	29	1	40	4	17	10	22	9	26	5
,, 9...	31	0	36	8	44	1	29	1	28	10	41	0	17	10	22	5	26	5
,, 16...	30	11	36	7	45	9	28	8	28	8	42	3	17	9	22	4	27	1
,, 23...	30	7	37	2	48	2	28	7	28	7	44	0	18	0	22	5	28	1
,, 30...	30	1	37	10	50	3	28	2	28	3	46	2	17	9	23	7	29	1
Nov. 6...	30	0	38	8	51	6	28	1	28	6	47	3	17	9	23	7	30	4
,, 13...	30	1	39	8	52	8	27	8	29	0	47	5	17	11	24	8	30	11
,, 20...	30	4	41	0	53	6	27	5	29	8	47	11	18	1	25	5	31	3
,, 27...	30	9	41	11	54	2	27	0	30	3	48	7	18	4	25	8	31	1
Dec. 4...	31	2	42	2	53	7	26	8	30	2	48	11	18	4	25	9	30	11
,, 11...	31	2	42	1			26	5	29	11			18	6	25	9		
,, 18...	31	2	42	7			25	11	29	8			18	5	25	9		
,, 25...	31	0	43	3			25	10	29	9			18	4	25	11		

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of November, 1914 and 1915.

—	Wheat.		Barley.		Oats.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
London	42 4	54 11	30 10	49 4	24 11	31 10
Norwich	39 10	52 7	28 9	48 3	25 3	30 7
Peterborough	40 10	53 3	30 3	49 3	25 3	30 11
Lincoln	40 5	53 7	29 8	48 4	25 3	30 6
Doncaster	40 7	52 11	29 3	44 11	24 5	30 9
Salisbury	40 1	52 3	29 4	48 5	24 9	31 3

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

Harvey, W. J., and *Reppien, C.*—Denmark and the Danes: A Survey of Danish Life, Institutions, and Culture. (346 pp.) London: T. Fisher Unwin, 1915. 12*s.* 6*d.* net. [63(489).]

Foght, H. W.—Rural Denmark and its Schools. (355 pp.) New York: The Macmillan Company, 1915. 6*s.* net. [37(489).]

Wells, S. R.—Germany's Food. Can it Last? The German Case as Presented by German Experts. (232 pp.) London: University of London Press, 1915. 2*s.* net. [63(43).]

Knox, G. D.—The Spirit of the Soil: An Account of the Nitrogen Fixation in the Soil by Bacteria and of the Production of Auximones as Promoted by Bacterised Peat. (242 pp.) London: Constable & Co., 1915. 2*s.* 6*d.* net. [576·83; 662·6.]

Redfield, C. L.—Dynamic Evolution: A Study of the Causes of Evolution and Degeneracy. (210 pp.) New York and London: G. P. Putnam's Sons, 1914. [575·1.]

Cornwall County Council.—Suggestions for the Assistance of Women's Committees . . . to Organise the Labour of Women and Girls in Cornwall, who are willing to help in Agricultural Pursuits during the War. (17 pp.) 1915. [376.]

Field Crops—

Amos, P. A.—Processes of Flour Manufacture. (280 pp.) London: Longmans, Green & Co., 1912. 4*s.* 6*d.* net. [664·6.]

Carter, H. R.—Cordage Fibres: Their Cultivation, Extraction, and Preparation for Market. (112 pp.) London: John Bale, Sons & Danielsson, 1909. 2*s.* 6*d.* net. [63·341.]

Rome, International Institute of Agriculture.—Statistical Notes on the Production, Imports, and Exports, Prices, and Maritime Freights of Cereals. (39 pp.) Rome, 1915. 25 centimes. [63·31:31.]

Perfumery and Essential Oil Record.—Special Number, 11th June, 1915. The Chemistry, Analysis, and Technology of Essential Oils, with Notes on other Natural Perfumery Products. (141-196 pp.) [63·345.]

Norway, Bureau Central de Statistique.—Données sur les Prix du Blé et des Pommes de Terre, 1836-1914. (32 + 33 pp.). Kristiania, 1915. [63·31:31; 63·512:31.]

(4185.) Wt. 864—P. 16. 7250. 12/15. J. T. & S., Ltd.

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 10.

JANUARY, 1916.

THE WAY IN WHICH WOMEN CAN ASSIST AGRICULTURE AND THE INCREASED PRODUCTION OF FOOD DURING THE WAR.*

EILIDH HAY FORBES

(Drumminor, Church Stretton),

The Girls' High School, Shrewsbury.

NIGHT after night the big ships sail out into the starlit darkness, carrying men, and yet more men, away from the peaceful shores of Britain to the reddened fields of France, or the sandy beaches of Gallipoli. Cheerful and confident, the men go forth to battle for us, and we women are left at home, face to face, many of us for the first time in our lives, with anxiety, sorrow, and dire need. Few men are left, and they are needed in the arsenals and munition factories, therefore on the women of the nation falls the burden of producing the food supplies. No longer is it true that " men must work and women must weep "—all must put their shoulders to the wheel, and answer the country's call in this her hour of need. Now that the highways of the ocean are less safe than of yore, it is imperative that more food should be produced in the

* A well-known member of the Salop County Council, who is keenly interested in the quest on of agricultural work for women during the war, offered three prizes for competition amongst pupils in the secondary schools in the county for the best essays dealing with the subject. The anonymous donor also undertook to pay for the printing of the best essay, trusting that the voice of youthful Shropshire speaking in this essay to members of the Parish War Committees may help the cause in which all are interested.

A copy of the essay was forwarded to the Board by the Secretary for Higher Education of the Salop County Council, and, with the consent of the Local Authority, the President has decided to reprint in the *Journal* this school-girl's appeal to the women of England.

country itself, so that the Army, the Navy, the wounded, and, above all, the children, who will be the future men and women of the Empire, may be adequately supplied. At a time when the nation is being called upon to bear a tremendous strain morally, physically and financially, it is of the utmost importance that the food supply should be well maintained. But how can this be unless the women lend their help ? Women of England! here lies your great opportunity, which may not come again! For years you have claimed equal rights with men, show now that you are worthy of them, and can fill a man's place !

In some mysterious, indefinable way the womanhood of the country has become impregnated with the idea that work on the land is degrading. Some think it beneath them, others that it is too strenuous, and others that it detracts from their femininity. In France and other continental nations this is not so; in fact, there are but few countries where women do so little outdoor work as in England. But who has felt the breath of the clover-scented air blowing on his face, and has watched the first pink flushes of dawn stealing across the sky, and still could think such work degrading? Who is there who has stood in the twilight, watching the stars come out in the quiet sky, and has not felt fully repaid for his day of toil ?

Oh! if only women could see that there is nothing derogatory in field-work, that it need not detract from their womanliness in the slightest degree, they would hasten "out into the fields of God." and

> " . . there among the husking of the corn,
> Where drowsy poppies nod,
> Where ill thoughts die and good are born,"

they would find comfort for their weary hearts, while the companionship of the fields and woods would ease the pain of waiting, and the dull ache of their sorrowful spirits.

It is not, however, only the women themselves who are prejudiced against agricultural work, but the farmers, in many cases, refuse to employ female labour, on the grounds that women are incompetent, and are not sufficiently strong. Both these objections may be reasonable enough, for many women have taken up farming for the sake of the novelty it offered, while others have attempted tasks far beyond their strength. Much work on farms, however, is particularly adapted to women. Milking, feeding and tending the animals, belong to their proper sphere, so do sowing, planting, and all the lighter kinds of work in the fields. It is not advisable for them

to undertake such a heavy job as ploughing, since it involves too great a physical strain. Most women would derive much benefit from the regular hours, good food and open-air life of a farm, and this would be not only for their benefit, but for the ultimate good of the race. Such tasks as fruit-picking, harvesting and all kinds of market-gardening are pre-eminently suited to women, while anyone with experience of horses can render untold service by learning to use one of the many horse-drawn machines now used in farm labour. She would thus set free any available male labour for the more arduous tasks. Nevertheless, there are some women who are bound by home-ties, and cannot do farm-work or gardening, but they, too, can do their part. They can cultivate any small allotment or strip of ground they may own, and thus provide vegetables for the family. They may, perhaps, be able to keep a goat or two, and goat's milk is a valuable food; they might keep rabbits, fowls or bees; and some might even venture on the ever-profitable pig!

All can do their share, none are too weak or small to take their part in the maintenance of the nation's food-supply. And who shall say that in the consciousness of helping others, and in the quiet simple life lived very close to nature, our anxious hearts shall not be lightened, and the burden of grief lifted from many a laden soul, so that we shall look forward in calm confidence to the time when victory shall crown our efforts, and peace once more reign on the earth?

PLANT DISEASES IN ENGLAND AND WALES, 1914-15.

OWING to the necessity for curtailing official expenses, and on account of the reorganisation of the staff during the war, it has been decided to suspend for the present the issue of the annual reports of the Horticulture Branch of the Board. The following statement, however, has been prepared to explain the position of affairs as regards the more important diseases of plants in this country, and to show that action has been taken to control them:—

Fungus Diseases.—The more important diseases of plants in England are of fungus origin, and they undoubtedly cause greater losses than those caused by insects. Three serious

diseases of this character, viz., American Gooseberry Mildew (*Sphaerotheca mors-uvae*), Wart Disease of Potatoes (*Synchytrium endobioticum*), and Corky Scab (*Spongospora subterranea*) are dealt with by Special Orders, while several others have been made the subject of special inquiry by the Board.

American Gooseberry Mildew.—The intensity of most fungus diseases is dependent to a great extent on the weather conditions which prevail at certain seasons of the year, and even a comparatively short period of conditions favourable to the development of the disease is apt to produce an increase of infection which places the disease, temporarily at least, beyond control, unless remedial measures are taken promptly. Such a state of affairs occurred in the spring of 1914. The mild, forcing weather which prevailed for some weeks led not only to the appearance of the summer stages of American Gooseberry Mildew at an earlier date than had been previously recorded in England, but also to an unusually severe attack on the fruit. In many gardens a considerable proportion of the fruit was rendered unfit for consumption, but, unfortunately, this did not mean that it was rendered unfit for sale, and many consignments were sent to market so badly affected that it was impossible to believe that the growers were ignorant of their condition. It is well known that when in this state not only the gooseberries themselves, but also the packages in which they are contained, are liable to spread infection, and in many gardens the appearance of the disease can be directly traced to the use of salesmen's baskets. The sale of diseased gooseberries has accordingly been made illegal by the American Gooseberry Mildew (Fruit) Order. At the instigation of the Board the markets were closely inspected and affected consignments rejected. In a few cases where the offence seemed deliberate the offenders were prosecuted, and the penalties in one or two instances were substantial, but in the majority of cases a warning letter was considered sufficient.

By this means the attention of fruit-growers was drawn to the dangers attending the consignment of diseased fruit, and the increase in the quantity of berries rendered useless by the mildew led many growers for the first time to appreciate the serious nature of the disease, and the importance of dealing with it promptly. Many badly-infected gardens were, therefore, grubbed, and in many other cases a determined effort was made to get rid of all traces of infection at an earlier date than usual. Unfortunately, war broke out at the very moment

when such work should have been begun, and the general disorganisation of industry which prevailed for a few weeks prevented much progress being made. Labour difficulties arose, and, as the fruit harvest was very large, all available hands were drawn off to pick the plums and apples. As a set-off to these troubles the weather continued to be very fine for several weeks, and prevented any serious development of mildew, so that, apart from any remedial operations, the amount of disease was probably no higher than in previous years. By general admission, however, though the extent was greater the intensity of attack was less. Full advantage was taken of this opportunity by many of the best growers, who found themselves able to secure adequate labour, and, as a rule, the gardens were passed as having been satisfactorily treated at a much earlier date than usual.

The result of this improvement was very clearly shown in 1915, when disease reappeared at a slightly later date than in 1914, and did not prove troublesome till the long drought that prevailed in the spring had affected the resisting power of the bushes. Even then, though many diseased consignments appeared in the markets, and a few prosecutions followed, it is the opinion of all the inspectors that the general condition of the fruit was far better than in the previous year, and that the consignments sent to market were, on the whole, far cleaner. Nor was this merely a general observation. Particular instances could be quoted to show that the disease can be kept in hand by prompt and proper tipping. Certain growers, who were known to have been much troubled in the past, picked fruit in 1915 that was almost clean, while in other cases the amount of disease present clearly indicated the precise point at which pruning operations were suspended.

The present position indicates the possibility of a great improvement, if fruit-growers can only be induced to carry out the work of tipping the bushes at the proper date, viz., between "the soft and the hard fruit." The high price obtainable for clean fruit in 1915 may also lead to a better appreciation of the advantages to be gained by the very simple method of dealing with the disease which the Board are attempting to enforce.

Several experiments were conducted to test the effect of sprays of different kinds, and under different conditions, on the mildew, both in the stage when it is growing rapidly and during the dormant season. Particulars of these experiments have, in most cases, already been published in this *Journal*.

They indicated that where a powerful fungicide is applied by a skilled operator at suitable intervals, and under favourable conditions of weather, the disease may be checked to a marked extent, but in no cases was it demonstrated that the mildew could be completely killed. The question of expense would also prove a serious bar to the general adoption of this method of dealing with disease, the more so as a spray, however effective when properly used, might be useless if unskilfully applied, or applied at the wrong time. Moreover, a fungicide has no beneficial effect beyond the destruction of the disease, while judicious pruning may not only remove disease but may also prove of distinct cultural advantage to the bush. The results of the experiments have confirmed the policy advocated by the Board, and show that, while spraying and tipping are the best remedy against American Gooseberry Mildew, tipping alone is distinctly valuable, while spraying alone cannot be depended upon.

During 1914, consignments of diseased gooseberries were imported from France, and there is now no European country where gooseberries are grown in which the disease is unknown. The disease has taken 10 years to spread across Europe, but its progress has been steady and continuous. Various methods have been adopted in the countries where it has appeared, but it is believed that in no country have the operations been more successful than in England, or more likely to lead ultimately to a satisfactory control of the disease.

Wart Disease of Potatoes.—An account of the present position of Wart Disease in England and Wales must take into consideration the important fact that the country can be divided into two districts, (1) the industrial part of England and Wales, in which the disease is very prevalent and often very destructive, and (2) the agricultural part of the country in which only sporadic cases exist—generally in allotments or small gardens, and never of any serious importance so far as the national crop is concerned, as the total of the diseased potatoes in this second area each year does not amount to a ton. The two groups of districts will be considered separately.

(1) *Industrial Districts.*—A large number of new cases of Wart Disease has been reported in these districts, but it is believed that a very large number remains to be discovered. Disease is concealed deliberately in some places, and in others is regarded with indifference, or is overlooked until a large area is affected. Further, the practice of only planting immune varieties, adopted by many occupiers who wish to

avoid the disease, though highly desirable in many ways, prevents the Board from ascertaining exactly which places are infected. In many places, however, outbreaks of disease are reported promptly, especially where public attention has been drawn to the necessity for notification by a prosecution for failure to inform the authorities.

The most disquieting circumstance that has occurred consists of the number of cases in which field-crops have been found to be affected, especially in Southern Lancashire and Northern Cheshire. The loss of crop in this district is considerable. Several groups of allotments, moreover, have been found to be infected so seriously that it has been necessary to form Special Orders declaring the whole group to be infected, and prohibiting the planting of potatoes thereon except by licence. The number of such infected areas is now over 200. Many of these Orders relate to places in Derbyshire and Staffordshire, but it has been necessary to schedule several areas in Manchester where the disease is very prevalent.

The procedure adopted by the Board in all cases is to prohibit the planting of potatoes on infected premises, or on an infected area, except by licence of the Board, but such licences are always issued when the applicant declares his intention of planting one or more of the varieties of potatoes proved experimentally to be resistant to Wart Disease, and undertakes to procure them from one of the dealers approved by the Board, who can give satisfactory assurances that the seed supplied will be true to type and free from "rogues." A large number of licences was issued last spring, and in the spring of 1914, to plant potatoes on these conditions, and it is satisfactory to be able to report that, except in one or two cases where serious doubt exists as to the correct variety having been supplied, no case has occurred in which disease has appeared on any of the varieties recommended. In several cases doubt has been cast upon the resistant powers of certain types, but upon investigation it has always been found that a susceptible variety has been substituted for a resistant one by an unscrupulous or careless dealer. Some of the resistant varieties have now been tested several thousand times, and have always proved to be absolutely immune. As, however, it was considered desirable to have a public demonstration of the fact, arrangements were made in the spring of 1915 to test a number of these potatoes on land near Ormskirk, which was well known to be badly infected, and the occasion was used to offer raisers of new varieties an opportunity of testing their potatoes

for resistance to Wart Disease. No less than 90 varieties were tested, and several excellent new varieties were found to be resistant. A list will be published at the earliest opportunity.

(2) *Agricultural Districts.*—The number of cases of Wart Disease in agricultural districts is very small, and such cases as do occur are to be found, with few exceptions, in the immediate neighbourhood of towns or small groups of dwelling-houses. Most of them are in the neighbourhood of London, Bristol, Lincoln, Swindon, etc., and only one or two cases have occurred in field-crops. The origin in these cases is most perplexing, and suggests that the disease may be dormant for a season under certain conditions. In most instances only one or two plants were affected, and in one case only has it been found necessary to declare an area infected. Whenever an isolated case is found the neighbouring premises have always been inspected, and the exact locality affected ascertained. A large number of crops have been inspected without any trace of disease being discovered. Although the spread of disease in this way is baffling and requires further study, there is no evidence that it is extensive or gives ground for any alarm. In every case the future planting of potatoes is rigorously controlled.

A few experiments have been made, chiefly with the object of testing the alleged successful treatment of infected soil described by Professor Eriksson.* Several badly-infected premises were taken, and the soil was treated with solutions of commercial formalin of different strengths. Susceptible varieties of potato were planted in the treated plot, with the usual "control" plot. The results showed no difference between the treated and the untreated plots. During 1915 a further experiment was made, under slightly different conditions, with no more success, and the evidence at present points to the conclusion that formalin is of no effect on badly-infected soil, at any rate in a solution not strong enough to affect the growing powers of the tuber. A small experiment was also carried out by a grower, who believed that the disease could be checked by the use of superphosphates. The results did not support his contention.

Corky Scab.—Another disease which has attracted a good deal of attention during the present season is the disease of potatoes known in England as Corky Scab, and in America as Powdery Scab. It is very local in England, and is practically unknown among the farms where potatoes are grown in large quantities. As a disease of potatoes in allotments, however,

* See *Journal*, May, 1914, p. 135.

it has proved to be of some importance in several places, almost entirely in those parts of the country where Wart Disease is prevalent. In a few cases it has been found in a high degree of intensity, and has proved to be quite as destructive as Wart Disease, and, as no cure or treatment is known, it is likely to prove very troublesome. Fortunately, it is a disease which spreads slowly and does not persist in well-cultivated soil. As every variety of potato appears to be subject to this disease any administrative action that may be taken will have to follow different lines from that adopted in the case of Wart Disease, but several points require to be settled before any such course can properly be adopted.

Other Fungus Pests.—Several other diseases are under investigation, chiefly with the object of ascertaining whether the conditions under which they prevail admit of concerted action. The progress of Silver Leaf among plums and apples has been watched, and an endeavour has been made to discover some action which could prevent its further spread. The subject of Apple Mildew is also engaging attention. In neither case has sufficient progress been made to warrant publication. The discovery of the disease known as *Dilophia graminis* in two places in England led to suggestions that it might prove a menace to the wheat harvest this year, but a general inquiry throughout England failed to reveal any other cases of the disease, and there is no reason to suppose that any serious harm was done. The Board's attention was called to a large number of cases of the more common fungus diseases of crops, but none was of sufficient importance to call for special notice.

Insect and Related Pests.—The insect pests which have given trouble during the past 18 months have been comparatively few, and, with one or two exceptions, have been those which have been known in this country for many years. No new case of *Phylloxera* has been found and, so far as is known, it does not exist in the kingdom. Investigations on the Large Larch Sawfly have been continued, and some interesting results obtained, but nothing conclusive. The epidemic appears to be dying down now, and during 1915 very little injury has been done anywhere. It is not yet possible to say if this is merely a temporary check, or whether some influence is at work which has permanently reduced the numbers of the sawflies.

Two insects of considerable importance have attracted attention during the last two years. The first is the well-known Japanese Fruit Scale (*Diaspis pentagona*), which has done such serious injury in Italy and elsewhere. The pest

has been introduced before, and was found to be capable of surviving an English winter, but had apparently died out. It was found to have been reintroduced under the following circumstances: Information having been received that some peach trees had been imported from America, inquiry was made at the place of destination to make quite sure that no disease had been introduced with them. They were found to be free, but the nursery in which they were growing was found to be infested with a number of exotic pests all new to this country, and some, as far as could be ascertained, new to science. Among the plants in the nursery were several ornamental cherry trees badly affected with the Japanese Fruit Scale. Steps were immediately taken to declare *Diaspis pentagona* a notifiable pest, and to stop all movement of trees from the nursery. Several plants were destroyed, and the rest were carefully cleansed of the scale and kept under observation till the following season. In the spring of 1915 a fresh examination took place, and several specimens of young scales were collected showing that the pest had again survived the peculiarities of an English winter. A further cleansing was ordered, and after some little trouble the owner was induced to destroy all the affected trees. Careful watch is being kept, but it is believed that all specimens have now been destroyed. It is highly important that this pest should not get a footing in English glass houses, as it might not only cause much injury under such conditions, but possibly might, after a time, become a serious trouble in English orchards in the southern counties.

The second pest is known by the name of the Capsid Bug. Several species have been discovered on affected trees, but at present it is not absolutely certain which is responsible for the great injury which is being caused, though the evidence points to *Plesiocoris rugicollis* being the culprit. Reports from the Board's inspectors show that much harm is being done in Kent, Cambridgeshire, Worcestershire, Suffolk, and other counties. The pest attacks apple trees, puncturing the fruit when young, and causing remarkable malformations which render the fruit absolutely useless in bad cases. Remedial treatment has been tried in several places with varying success, but the problem of how best to deal with the bug has not yet been settled. Further investigation is still proceeding.*

A very interesting attack of apple trees by *Hyponomeuta* in Nottingham has been under observation for some years. Certain remedial measures were suggested by the Board, and it was proposed to pass a local Order making their adoption

* See also article on Capsid Bugs at p. 950 of this issue of the *Journal*.

compulsory. The residents, however, protested against the Order, which was finally dropped, as the attack was purely local. No sooner was this done, however, than the measures suggested were adopted with complete success by the great majority of the owners of the trees, who, with greater expense and after experiencing considerable loss, demonstrated the value of the remedies they had rejected when proposed by the Board.

DISORDERS OF CIDER AND PERRY.

PROF. B. T. P. BARKER, M.A., and OTTO GROVE.

Agricultural and Horticultural Research Station, University of Bristol.

IN common with fermented liquors generally, cider and perry are subject to a number of disorders. As made on the farm for home use they are in most cases more or less completely fermented beverages, which contain little, if any, residual sugar. In this form they escape the liability to certain disorders which require the presence of appreciable quantities of sugar for their inception; but, even so, they are comparatively unstable liquors on account of their relatively low alcoholic content, which does not often exceed 6 to 7 per cent., while they frequently suffer from acetification and blackening, as well as occasional other troubles. For most commercial purposes, and under special conditions in some cases on the farm also, a sweeter type of beverage is produced, fermentation being arrested before the whole of the original sugar of the juice has disappeared. The quantity of unfermented sugar in such cases is very variable, but frequently exceeds 5 per cent. These ciders and perries are still more unstable than the "dry" types, and are very subject to special disorders, of which sickness, oiliness, and ropiness are the commonest, in addition to those which attack the "dry" types.

The following account deals briefly with the most prevalent disorders, and summarises their general characters, and the methods of prevention and treatment:—

Acetification.—The commonest disorder to which cider and perry are liable is undoubtedly acetification. Acetification is a special form of fermentation, the acetic or "vinegar" fermentation, in which the sugar and alcoholic contents of the affected liquor are converted into acetic acid. The disorder has long been known to be due to the action of bacteria which possess the power of acting on alcohol in the presence of air or oxygen—oxygen being the essential factor—and converting

it into acetic acid, the characteristic constituent of vinegar. All liquors containing sugar and alcohol below a certain strength are liable to this fermentation. On cider left exposed for several days to air a growth in the nature of a semi-transparent film of varying thickness quickly appears. This consists of a mass of the bacteria in question, and is commonly spoken of as the vinegar plant or "mother." The name of this type of bacterium is *Bacterium xylinum*. A number of other kinds of bacteria capable of producing acetification have from time to time been met with in cider and perry and in other fermented liquors, such as wines and beers. The organism named is, however, the most common in cider and perry.

All fermented liquors which contain relatively low amounts of alcohol (*i.e.*, less than 6 to 8 per cent.) are susceptible, the smaller the amount of alcohol the less being the power of resistance in general. Cider and perry, as drinks of weak alcoholic strength, are normally particularly liable. In slight cases the effect of acetic fermentation upon the general character of the liquor is not very marked. In more severe cases the flavour of the cider or perry becomes very adversely affected, acquiring a vinegar-like character which is not only unpleasant to the palate, but must also, in bad examples, have an injurious effect on the digestive organs. In extreme cases the liquor becomes undrinkable.

On account of the extreme prevalence of this disorder—there are few 6-months-old ciders made under ordinary circumstances which do not show some trace of it—and the difficulty of keeping it under entirely, the malady is a serious one for the maker, although with a little care there is no reason why any case should develop into a severe one.

Conditions Favouring Acetic Fermentation.—There are a number of distinct opportunities for the development of acetification during the making of cider and perry. Of these the more important may be briefly referred to.

(*a*) *Acetification during Storage of Fruit.*—It has long been known that cider and perry fruit during storage prior to milling is exceedingly liable to acetify or "heat" under certain conditions. Storage in too deep or large a heap, wetness of the fruit, a high temperature, and the presence of bruised, broken, or decaying fruit in the heap, are all factors favouring acetification during storage. They give rise to conditions suitable to the free development of the acetic bacteria on the surface of the sound fruit or in the tissues

of the bruised and broken fruit. Since the bacteria probably occur invariably on the skin of the fruit in nature, the cider maker is obliged to start with infected material, and has, therefore, to devote his energies to the prevention of the multiplication of the pest, rather than to the prevention of the infection.

(*b*) *Acetification during Maceration of Pomace.*—If, after the milling of the fruit, the pomace is allowed to stand before being pressed, the bacteria have abundant opportunity for activity unless care is taken. Soaking, or maceration, of the pomace for several hours before pressing frequently gives rise to trouble, especially if the weather is inclined to be warm, on account of the somewhat considerable exposure to air which generally takes place.

(*c*) *Acetification during Keeving.*—The practice of keeving the juice is risky for the same reason, unless measures are taken to bring it rapidly into a condition of fermentation. The solid matter which rises in the early stages of fermentation to form the brown head quickly becomes strongly acetic in character if care is not taken to prevent access of air. It should be removed by skimming, racking, or other means, before it has time to cause much damage.

(*d*) *Acetification during Fermentation.*—During the stage of active alcoholic fermentation chances of acetification are not serious, on account of the large quantities of carbon dioxide given off during this fermentation displacing the air immediately above the exposed surface of the fermenting juice. If, however, a large surface of juice is exposed, or if fermentation is on the slow side, there is a certain amount of risk. When active fermentation approaches its end the danger increases considerably unless air is kept away from the juice.

(*e*) *Acetification after Fermentation.*—After active alcoholic fermentation has ceased the risk of acetification is still greater. Cider and perry are peculiarly difficult to deal with at this stage, not only on account of their low alcoholic strength, but also because of the completeness with which alcoholic fermentation becomes played out in the majority of cases. So long as sufficient fermentation to keep the cider charged with carbonic acid can be maintained, the liquor is to a great extent self-protected against acetification. It is for this reason that the old practice of adding raisins or other substances capable of encouraging the continuance of a very slight fermentation after the final racking was found advantageous in many cases. The modern custom of filtration

has, however, greatly increased the risk of trouble at this stage, because it deprives the liquor of carbonic acid and leaves it dead and incapable of after-fermentation in many instances.

(*f*) *Acetification during Storage.*—After the cider has been put away in store casks, filled to the bung-hole, and tightly bunged, great deterioration often occurs on account of evaporation which seems to take place more or less regularly through the pores of the wood. An air space is thus formed above the liquor in the cask, and acetification begins to develop.

Prevention of Acetification.—For the prevention of acetification the three most important points to keep in view are (1) storage of fruit under satisfactory conditions, (2) the exclusion of air as completely as possible from the juice during and after fermentation, and (3) the storage of the finished cider at as low a temperature as possible. Acetic bacteria do not grow rapidly at a low temperature, and if the temperature of the cider cellar can be kept below 50° F. the amount of acetification which can take place is very limited indeed. There is no reason why the fruit should not be stored in a manner rendering the amount of acetification negligible, provided that it is gathered from the trees in a satisfactory condition. The chief points in storage are to keep the fruit in heaps which are not too deep nor too large. Storage under cover is probably preferable to storage in the open air without cover; but in any case it is most desirable to have a good current of air passing through the heap of fruit to keep the apples dry and to prevent "heating."

Satisfactory measures for checking acetification during the fermentation of the juice can easily be taken. When working according to the usual method, *i.e.*, fermenting the juice with the casks resting upon their sides and completely filled, there is very little danger in leaving the bung-hole open for the first week or 10 days; but after this, when froth is no longer discharged from the bung-hole, it is indispensable that the latter should be closed in such a way that the fermentation gas can escape but no air from outside get into the cask. There are several different forms of apparatus to achieve this object, all working on the same principle, *i.e.*, forming a liquid trap through which the fermentation gas escapes. The simplest form of these vent-tubes is a tube bent over at an angle of about 45 degrees, one end of which is passed through a cork bung fitted into the bung-hole of the cask, and the other dipped in a jar containing water. The tube

should be preferably made of glass, but metal tubes are sometimes used. Care should, however, be taken not to use lead tubing for the purpose on account of the risk of getting the cider contaminated with poisonous salts of lead.

To prevent access of air to cider during storage it is necessary to keep the cask completely filled and tightly bunged, filling up the air space that gradually forms above the liquor at regular intervals, *e.g.*, each fortnight, with cider kept for the purpose in small casks or bottles. To keep the bung-hole tightly closed, the use of special wooden bungs of a long, tapering shape, covered with several layers of canvas previously dipped in hot melted paraffin-wax, is recommended. These bungs should be about 6 to 8 in. in length, and of such a diameter that about one-third or one-half of the length enters the cask and dips into the cider. The role of the waxed canvas is to give the surface of the bung a certain elasticity, so that small irregularities in the shape of the bung-hole may be filled up. It is a good practice to coat the interior surface of the store casks with an even layer of paraffin-wax or some form of cask varnish. This checks evaporation through the wood, and air is thus more completely excluded.

For cider on draught it is very useful to connect the cask with one of the ordinary steel cylinders containing liquid carbonic acid gas, letting in a little of the gas as the liquor is withdrawn. The space above the liquor is thus kept filled with carbonic acid gas instead of air. As only very little gas is needed to keep the cider sparkling and free from acetification, one cylinder of gas is sufficient for a large number of casks, and the expense is consequently insignificant.

Another method of protecting the surface of the cider in casks on draught from the action of air consists in covering the liquor with a layer of oil. Any oil which imparts no flavour to the cider and does not turn rancid can be used. The best oil is, perhaps, liquid paraffin, because it is completely odourless and tasteless, and keeps indefinitely. The oil can be used again and again, as it does not mix with the cider and can be drawn off with the last few gallons in the cask and easily separated. The thickness of the layer of oil above the cider must be at least a quarter of an inch.

In casks on draught acetification is sometimes prevented by the burning of a small sulphur match in the empty space over the liquor. The burning sulphur consumes the oxygen present, and another gas—sulphur dioxide—is formed, which acts as an antiseptic.

Treatment of Acetified Cider.—In practice several methods of curing acetified cider are known, *e.g.*, mixing with sound cider or with fresh juice, re-fermenting, the addition of water and sugar, neutralisation of the acetic acid with lime, etc. All of these methods have in common the objection that the cause of the acetification, viz., the acetic bacterium, is not destroyed. For that reason acetification is apt to set in again quickly after treatment.

Badly-acetified ciders can generally be made drinkable by pouring them over freshly-pressed pomace, allowing the mixture to stand overnight, and then re-pressing. The proportion of the affected cider to be added to the pomace may be taken generally at the rate of 10 gal. of cider to 200 lb. of the pressed pomace. After re-pressing a limited amount of fermentation will set in. The re-soaked cider should be treated in every way like freshly-pressed juice. It is desirable that such ciders should be consumed as quickly as possible after treatment before further acetification can occur.

Cider Sickness.—Cider sickness is a very common disorder of cider in some districts. It also attacks perry. It usually makes its appearance during the middle or latter part of the summer, hot weather favouring its development. The first sign of sickness generally noticed is a violent evolution of gas, for which reason the disorder is commonly referred to as "second fermentation." The evolution is accompanied by an unpleasant change in the flavour and aroma of the cider, due in part at least to the formation of certain aldehydes. The affected liquor, in due course, generally becomes very turbid. The cider is rendered practically unsaleable, and the loss to the maker is especially great because it is usually the sweetest, richest, and most fruity ciders which are most subject to attack. The disorder is due to the action of a special organism, a bacterium which is probably present on the apples and is thus brought into the juice at the time of milling and pressing. This bacterium has several times been isolated from sick ciders. When a culture of it is added to a susceptible type of sound cider the latter will quickly turn sick. The disease is thus very contagious.

In the course of the fermentation brought about by the action of the sickness bacillus the sugar in the cider is more or less completely transformed into several different substances, of which alcohol and carbonic acid gas are the most *abundant*.

Conditions Favouring Sickness.—Sickness only develops in ciders when the conditions for the growth of the bacterium are favourable, although probably the organism is always present. Practical experience and the results of experimental work have shown that the factors which are of most importance in favouring the development of sickness are (*a*) a high temperature, (*b*) low acidity of the cider, and (*c*) a slow rate of primary fermentation.

If the cider is kept at a temperature below 50° F. sickness rarely develops, since the sickness bacteria only grow freely at a comparatively high temperature. Hence cider should always be stored at as low a temperature as possible.

The natural acidity of the cider is of the first importance in connection with susceptibility to sickness. As a general rule the more malic acid there is present the less liable the cider is to sickness. Experiments have shown that unless the amount of malic acid exceeds 0·5 per cent. it is insufficient by itself to prevent sickness. Occasionally ciders with as much as 0·6 per cent. of malic acid turn sick. This, however, is rare; and a high content of malic acid of the cider is the best-known preventive against the disorder.

It is repeatedly found that ciders which have been made rom juices which have fermented slowly are far more liable o sickness than those made from juices which possess a aturally rapid rate of fermentation. This is probably due o two reasons. Firstly, the ciders made from slow-fermenting uices generally contain more residual sugar than those made rom quickly-fermenting juices. Since sugar is required for the levelopment of the disease, sweet ciders are most liable to t. Secondly, it is probable that, when the initial rate of ermentation of a juice is slow, the development of sickness acteria in the juice is more considerable than when alcoholic ermentation sets in rapidly and is vigorous. Consequently he bacteria have a greater chance of causing sickness later.

Prevention of Sickness.—Since it is certain that sickness acteria are very widely spread, and probably occur in most, not all, juices, the surest means of warding off the disorder to produce a type of cider more or less immune to attack. his can largely be accomplished by blending, the aim being produce a mixture which shall rapidly come into fermentation d continue to ferment at a fairly rapid rate, and which has degree of acidity as high as considerations of palatability ill allow. After fermentation, it should be stored at as w a temperature as possible.

In the case of bottled ciders experiments have shown that ciders bottled very early in the season are much less liable to sickness than those bottled late. Consequently it is desirable to get ciders bottled as early as possible in the year, although discretion is necessary to select types for bottling which will not throw too heavy a deposit as a result of the early bottling.

Since the disease is caused by bacteria, and is, therefore, contagious, it is important that strict attention should be paid to cleanliness; and it is desirable that all vessels and appliances with which an affected cider has come into contact should be sterilised as efficiently as possible by steam, or by washing with a suitable antiseptic so that the risk of infection should be reduced as far as possible.

Treatment of Sick Cider.—As regards a cure for sick cider, there is little which can be done if sickness is in a very advanced state, since the flavour and composition of the affected cider are radically altered. In most instances the characteristic odour and flavour of sickness pass off on long standing, and the turbidity may also disappear owing to the material which causes it being deposited. The cider, however, will have to a greater or less extent lost its sweetness, and on that account be rendered of much less value than originally.

In the early stages of sickness, or in cases where the cider is known to be of a type liable to sickness, it is possible to remedy or prevent the trouble either by increasing the acidity or by re-fermenting the liquor.

The simplest and best way of increasing the acidity is by blending the cider with such a proportion of a sharper type that the acidity of the blend is raised to about 0·6 per cent. malic acid. If a very sharp cider is not available for blending, the same effect can be obtained by adding to the cider requiring treatment sufficient tartaric or citric acid to raise the acidity to the equivalent of the point mentioned.

To re-ferment the cider, brewers' yeast can be used in the proportion of 1 gal. of thick yeast to 100 gal. of cider. Before adding the yeast it must be carefully washed by stirring it up with cold water, which is poured off when the yeast has settled down. This operation must be repeated three or four times until the yeast becomes quite white and is without smell or taste of hops. An active fermentation should be allowed to proceed for a few days, and when the specific gravity has fallen by from 5 to 10 points fermentation should be stopped by filtration.

Oiliness and Ropiness.—These disorders of cider and perry are fairly common, and attack many different types of these

liquors. As a rule the sweeter ciders and perries containing small percentages of alcohol and acid are more liable to attack than sharper and drier ones. Cider and perry to which sugar has been added are very frequently subject to attack. The symptoms of the disorder are a more or less pronounced development of cloudiness in the liquor, accompanied by a change in the liquor itself, which renders it more or less viscous, so that when poured out of a bottle it flows like oil or, in bad cases, like a string of mucilage.

While there is probably no essential difference between oiliness and ropiness, the two names are used to denote two distinct differences in character of the disorder. An oily cider is probably one which has been attacked only lightly by the disorder, or in which the disorder is in an early stage. As the name denotes, the liquid is more or less oily in character. A ropy cider is one in which the disorder has developed to a considerable degree, with the result that the whole liquid has the characteristic mucilaginous or ropy character.

The malady is caused by certain kinds of bacteria which act on the sugar in the cider, converting it more or less completely into mucilaginous substances which give to the liquor the oily or ropy character.

Prevention of Oiliness and Ropiness.—As this disease especially attacks ciders of the types which are liable to cider sickness, the same means of prevention (see section on cider sickness) can be employed, viz., cleanliness, increase of the acidity of the liquor by using a good proportion of sharp fruit, a quick initial fermentation, and storage of the liquor at a low temperature.

Treatment of Oily and Ropy Cider.—There are several ways of treating an oily or ropy cider to render it fit for use.

(*a*) If the disorder is not very far advanced it is sometimes sufficient to pour the cider into open vessels, stirring it vigorously so as to expose it as much as possible to the influence of air. Afterwards it is left for some time in closed casks and racked or filtered from the deposit.

(*b*) In more severe cases it is necessary to employ a clearing agent which, by the formation of a precipitate in the liquor, causes the separation of the mucilaginous material at the same time and carries it to the bottom of the cask with the precipitate. The most commonly used agent of this sort is tannin in combination with gelatine. The tannin is added first, previously dissolved in a little warm water. When it is we mixed with the cider the gelatine—also previously dissolved

in warm water—is added. After this has been thoroughly mixed the treated cider is left in closed casks until clear, and then filtered or racked from the deposit into clean casks. The proportions of gelatine and tannin required vary according to the different ciders and perries, and are best ascertained by making a few tests on a small scale before treating the bulk of the liquor. Generally, 1½ oz. of tannin and 2 oz. of gelatine per 100 gal. of oily cider give satisfactory results.

Another clearing agent sometimes used is a natural pure clay, such as kaolin or white china clay. This is employed in a proportion of from 2 lb. to 5 lb. of clay per 100 gal. of cider. It must first be ground to a fine semi-liquid paste with a little cider before adding it to the bulk. During this addition the cider is vigorously stirred and then left undisturbed in the casks for a few days, after which it is racked or filtered from the deposit.

Blackening of Cider. — Some months after making many ciders and perries become subject to considerable discoloration after being drawn from cask or poured from bottle and exposed to the action of air for a short time. The change in colour begins at the exposed surface, and gradually passes down through the bulk of the liquid. The rapidity of the discoloration varies considerably in individual cases. Sometimes it is shown conspicuously in a few minutes, and at other times the liquor may stand an hour or more before it becomes noticeable. The change in colour which cider undergoes varies somewhat ; but generally its characteristic amber colour acquires a dirty brown or greenish-black tinge, and in bad cases the whole liquid may eventually acquire a pronounced greenish-black colour. The various changes in colour have from time to time been ascribed to a variety of causes, but undoubtedly the commonest is the presence of soluble compounds of iron in the liquor. The iron present combines with the tannin of the cider, forming with it a substance which on oxidation becomes greenish-black in colour. So long as the cider is well charged with carbonic acid gas, the oxidation of this compound by exposure to air is rendered impossible; but the longer the cider stands exposed to air, and thus loses its carbonic acid gas, the more completely oxidation takes place, and the development of the greenish-black colour ensues.

As a general rule the discoloration of ciders containing relatively high amounts of malic acid is not so marked as that of ciders containing low amounts, since the acidity affects the formation of the iron-tannin compound. Hence ciders

of low acidities are especially liable to this disorder; and one means of reducing the trouble is, therefore, to raise the acidity of the cider by blending with a more acid type.

When the liability to blacken has once developed in a cider, little can be done to remedy the trouble. The addition of about an ounce of tannin, dissolved in a little warm water, per 100 gal. of cider, causes a precipitation of the iron-tannin compound and results in some improvement.

Ciders which have turned black gradually return to their normal colour after standing, if the vessels containing them are closed tightly. As the liquor charges itself with carbonic acid gas again the oxidised iron-tannin compound is reduced to the colourless form.

The prevention of blackening is much more important than the treatment of affected cases. The iron gets into the juice from the iron mill, iron shovels, and other appliances containing iron used in connection with the milling and pressing of the fruit. It is also possible that soil adhering to the apples in some cases carries compounds of iron into the juice. It is consequently essential to use only when strictly necessary appliances containing iron likely to come into contact with the apples, the pulp, or the juice, and to clean them thoroughly before and after use. It is especially important that the juice and particles of the pomace should be removed from the mill when milling is finished for the day. Otherwise the acid of the fruit will dissolve some of the iron in the mill, and this will be carried into the juice by the first lot of pomace passing through the mill the following day of use.

It appears to be an accepted fact among cider makers that cider made from fruit grown on certain soils is more subject to blackening than that made from similar kinds grown on other soils. The reason for this is not known with certainty; but it is well known that on some soils the normal acidity of a variety is reduced, and this reduction of acidity may, therefore, render the cider more susceptible to blackening, as stated above. It is also possible that fruit grown on certain soils may contain larger quantities of iron in the juice than that grown on other soils. Apple juice invariably contains traces of iron, and it is conceivable that if the iron is present in any appreciable quantity the juice may become discoloured after fermentation. Another possibility is that the particles of soil which, accidentally, but almost invariably, find their way into the juice, during milling and pressing, may be responsible when the soil is rich in iron.

CAPSID BUGS.

J. C. F. FRYER, M.A.,

Entomologist to the Board of Agriculture and Fisheries.

THE following paper gives a brief summary of the present state of our knowledge with regard to the injury to apple trees and fruit now generally ascribed to plant bugs of the family *Capsidæ.*

As will appear subsequently, the subject is complicated in many ways, and it is necessary, therefore, to avoid definite statements which might ultimately prove misleading. The various problems are under investigation, but help is needed, and it is hoped that the notes now given will be of assistance in showing the directions along which further observations may be most usefully made. At the same time, the reader should be warned that, as with all incomplete investigations, it is impossible to give any useful account without introducing a certain amount of technical matter. Correspondence will be welcomed, however, with regard to any point which may need explanation.

Nature of Injury.*—While discussion as to the species of insect responsible for the damage must be left to a later section, it is necessary, in describing the nature of the injury, to state that its first cause is a puncture in the tissues of the plant made by an insect when feeding. A large Order of insects, comprising the aphides, scale insects, plant bugs and others, feed by inserting their proboscides (or trunks) into the plant and by sucking up its juices. In many cases the puncture heals rapidly, leaving only a minute scar to show its position, but in others the portions of the plant surrounding the puncture appear as if poisoned, and either die or undergo an abnormal development.

In the case of the Capsid attack on apples, the leaves, shoots and fruitlets are punctured when quite young, and the tissues surrounding each puncture are seriously injured. The leaves at first show scattered red or brown spots, marking the site of each puncture, but later these discoloured areas die and frequently drop out, leaving an undersized and ragged leaf which is incapable of doing its share in supporting the plant. The shoots " bleed " freely from each puncture and are stunted or sometimes killed. The terminal shoot on each branch suffers most severely, and there is, in consequence, an excessive production of short lateral twigs which often give a characteristic appearance to attacked trees. The fruit shows greater

variation in the nature of the injury. In mild cases it becomes deformed, some parts failing to develop, while others seem to be stimulated abnormally so that there are scattered pits and pimples over the surface. The skin, as a rule, shows rough, discoloured areas, which are sharply divided from the normal parts and suggest scars following wounds which have healed in an unhealthy manner. In severe cases the apple is distorted and almost shapeless; cracks appear at the positions of the original punctures, and widen as the fruit grows, sometimes penetrating even to the core. The surface is often very rough and corky, and the flesh underneath more or less shrivelled.

As is natural, when fruits are so injured, many never become mature but fall off when they are about half-grown. For this reason it is impossible to estimate the full damage done in an affected orchard, but it is not uncommon to find that from 20 to 30 per cent. of the mature crop must be rejected as unsaleable or fit only for boiling.

With regard to the means of distinguishing the attack in an orchard, the variety and extent of the damage is in itself suggestive, but it must always be remembered that any injury to the skin of the young fruit may produce scars later. During a bad aphis attack, for instance, the apples are often punctured, and may, in consequence, become deformed or marked much as in the case of an attack by Capsids. The scab fungus (*Fusicladium*) may also produce evident cracking.

It is not wise, therefore, to diagnose Capsid damage on the evidence of one or two "specimen" fruits alone. The attack, however, usually persists from year to year, and if a large number of marked apples are noted in the autumn, Capsids may be suspected, and the suspicion confirmed in the following spring by the discovery of the injuries to the foliage and shoots previously described.

Varieties of Apple Attacked.—In an affected orchard it is usually noticed that some varieties of apple are much more seriously damaged than others, but observations from different districts do not wholly agree. It may be of interest, however, to give the following notes on those varieties which have behaved more or less consistently.

Varieties which suffer very slightly are Bramley's Seedling and Early Victoria (Emneth Early). Varieties which are usually seriously injured are Allington Pippin, Beauty of Bath, Gladstone, Grenadier, King of the Pippins, Lanes' Prince Albert, Lord Derby, Lord Grosvenor, and Worcester Pearmain. It would obviously be unwise to advance any theories in con-

nection with such a miscellaneous collection until further evidence is obtained.

Insects Responsible.—Although it is probable that the injuries described above have been observed occasionally for a number of years, it is only recently that attention has been attracted to their origin. Inclement weather conditions, physiological defects in the tree, and various insects other than plant bugs, have been given as the true causes and, while it is undoubted that marked fruit may at times be produced by some or all of them, in those cases which have lately been investigated Capsid bugs have been found responsible.

The literature dealing with the attacks of these insects on apple on the Continent of Europe is very scanty, and reference need only be made to the writings of Schoyen, who has recorded the typical injury in Norway, and attributes it primarily to two bugs known as *Plesiocoris rugicollis* and *Orthotylus marginalis*. In the United States and Canada Capsid damage is well known, and from illustrations would seem to be precisely similar to that observed in England. The bugs responsible, however, do not occur in Britain, and no further reference need be made to them at this point.

The first published reference to the apple attack in this country would appear to be a note by Mr. Theobald in his Report for 1910. The same author again refers to the subject in his subsequent Reports for 1911–12–13, and shows that suspicion must be cast on four species of bug: *Plesiocoris rugicollis*, *Orthotylus marginalis*, *Atractotomus mali*, *Psallus ambiguus*. During the same period Dr. MacDougall, then adviser to the Board in agricultural zoology, also received these species from orchards showing the typical Capsid injury. In 1912, a further species of Capsid (*Lygus pratensis*), the "tarnished plant bug" was shown by Collinge to be capable of producing dimples on apples by depositing eggs on the young fruit. The writer of the present account was brought in touch with the problem in 1913, and, with the assistance of the Board's inspectors, opened an investigation to discover which of these bugs was responsible for the typical injury. The last-named, *Lygus pratensis*, was easily dismissed, and the remaining species may, for convenience, be divided into two groups, of which the first containing *Plesiocoris rugicollis* and *Orthotylus marginalis* are green when full grown, and the second containing *Atractotomus mali* and *Psallus ambiguus* are red or brown. Growers in almost all the cases visited pointed to the green Capsids as the culprits, and some had even carried out

the following interesting experiment to prove that this was so. Trusses of apples were enclosed in muslin with the bugs, while other trusses were protected from their attacks in the same manner. The former developed the typical injury, while the latter remained sound.

To obtain further evidence a census of the bugs found in abundance in affected orchards is being made, and, for comparison, the same has also been done in a large number of free orchards. The results up to date, as regards the former, are shown in the following table; the latter are summarised in one line to avoid unnecessary repetition.

County.	*P. rugicollis.*	*O. marginalis.*	*A. mali.*	*P. ambiguus.*
Worcester A ..	X	X	X	X
,, B ..	X	X	O	X
,, C ..	X	X	X	X
Notts A ..	O	X	O	X
Suffolk A ..	X	O	X	X
Cambs A ..	X	X	O	X
,, B ..	X	X	O	X
,, C ..	X	X	O	X
,, D ..	X	O	O	X
Unaffected (generalised) ..	O	O	O or X	X

X = present; O = absent.

As regards these cases, it is evident that the brown Capsids are not of first importance, for *Psallus ambiguus* has been present in abundance in all orchards visited whether affected or not, while *Atractotomus mali* was absent in six orchards which were seriously injured. With reference to the green Capsids, it appears that one or other species has been present in every affected orchard, while they were absent in all unaffected orchards. (It should be mentioned that three *O. marginalis* were obtained with difficulty in one free Worcester orchard.)

The census, therefore, provides further evidence that the green Capsids are the true culprits, and, as regards the question as to which of the two is the more injurious, it may be pointed out that *P. rugicollis* was present alone in Suffolk A and Cambs D, and the injury in these orchards was very serious. In Cambs A, B, C, it was notably the most numerous species, while in Notts A, where *O. marginalis* was present alone, the injury was less than in any of the other cases tabulated above. From field observations, therefore, it seems that *P. rugicollis* must be regarded as the more serious pest.

Experimental evidence to confirm these deductions is being obtained as opportunity offers, but the work requires closer application than can usually be given at the busiest time of the year. The experiment of sleeving the green Capsids on selected trusses has already been mentioned, and it is only possible to cite one further experiment made in May, 1915. In this case, three small apple branches were enclosed with young *Psallus ambiguus* which were left for four days, and though the bugs were observed feeding no obvious injury was produced. The *Psallus* were then removed from two of the branches and were replaced by young *Plesiocoris rugicollis* (as was subsequently proved) from Cambs D. After a period of a week the leaves enclosed with *Plesiocoris* were covered with brown spots, and the young shoots were "bleeding" from numerous punctures. The third branch, however, on which *Psallus* were still living, continued to show no evident injury. The case against *P. rugicollis*, therefore, may almost be considered as proved. Experiments to conclude this side of the investigation as regards the green Capsids have been planned, and it is hoped, if circumstances permit, to carry them out next season.

Description of Insects.—Full technical descriptions of the adult insects mentioned above may be obtained from a work on British Hemiptera, and it is difficult to give features by which the young bugs can be separated without assuming that they can be properly mounted and examined under a microscope. In general, however, they are about $\frac{1}{16}$ in. in length when first observed, and are all greenish or yellowish in colour. They are wingless, and are only likely to be confused with aphides, from which they may be distinguished by their extreme activity.

The adult bugs are winged, and their general appearance is shown in Fig. 1. The green Capsids closely resemble each other to the naked eye, and can hardly be distinguished in the field until the observer has become thoroughly familiar with them. With an ordinary pocket lens it is not difficult to see that *Plesiocoris* has a ring-like collar round the neck, and is almost hairless, while *Orthotylus* has no collar and is clothed with fine hairs.

The eggs of these Capsids seem never to have been described. Those of *Plesiocoris* were observed in 1915. In shape they are elongate, and somewhat resemble the rubber portion of a fountain-pen filler, or a soda-water bottle. They are about $\frac{1}{16}$ in. in length, and are translucent white in colour, but are seldom likely to be observed owing to their situation, which is described in the following section.

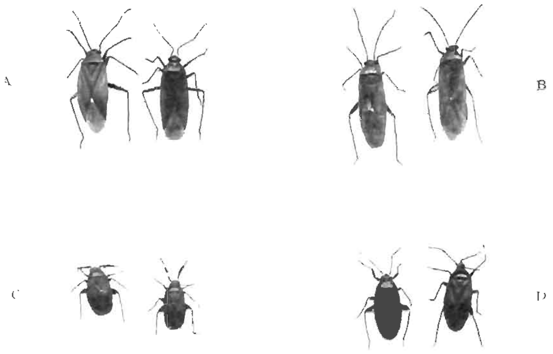
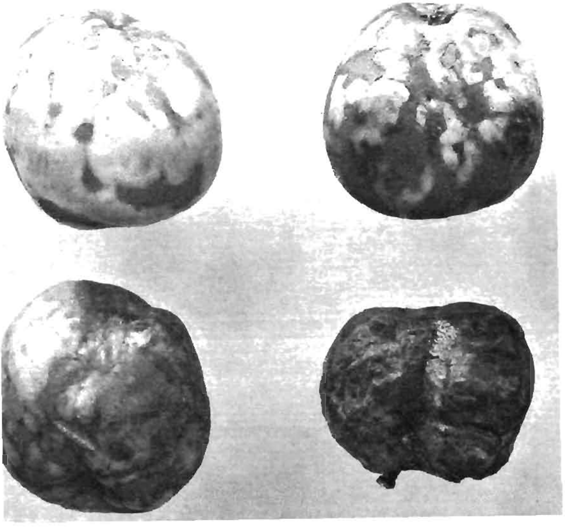


FIG. 1—A. *Plesiocoris rugicollis.* B. *Orthotylus marginalis.*
C. *Atractotomus mali.* D. *Psallus ambiguus.*
Each specimen × 3.
(*The Board are indebted to the Cambridge University Press for the loan of the blocks of the illustrations in Fig.* 1.)



Life History and Habits of the Green Capsids.—The habits of both *Plesiocoris* and *Orthotylus* are much alike, but the following notes refer to the former species unless otherwise stated:—

Egg laying would seem to take place from the end of June to the beginning of August. In some cases all the bugs have disappeared by the middle of July, but in others they were found until the middle of August. In the case of apple, later records than this must be accepted with reserve owing to the ease with which these bugs may be confused with other green Capsids, which may, when adult, wander on to apples. Eggs were first obtained from specimens in captivity, and were discovered deeply imbedded in the twigs at the base of the new seasons growth and in the wood of the previous year. They were inserted for their whole length, and in most cases no signs of their presence could be found on the surface of the twig. As a rule, they seem to have been laid through the lenticels (breathing pores) in the bark, but it is not certain that this is always so. Similar eggs have since been found in twigs obtained from Cambs A, and a preference is shown for the wood formed in the previous season. In captivity two or even four eggs were often placed together, but in the open the eggs usually appear to be laid singly. These statements, however, must not be taken as final, for, owing to the difficulty of finding eggs, the number examined has not been large. The eggs remain for the autumn and winter, and give rise to young bugs during the latter half of April, the earliest date recorded being 14th April.

When first hatched the young insects creep in between the developing leaves and flower buds, and are not easily dislodged. As the leaves expand, and the flower buds separate, they may be found crawling actively about among the flowers and leaves, which soon show the characteristic punctures. The bugs grow rapidly, and by the middle of May many are half-grown. By this time they have become even more active, and if a branch on which they rest is shaken, or an attempt is made to catch them, they frequently fall to the ground. From the middle of May onwards, forms with developing wings are numerous, and about the end of May the last skin is shed and the mature winged form appears. The adult bugs are also exceedingly active, attempting, as a rule, to escape by running or falling, but in bright sun they fly readily, though they do not seem to travel far. Under no circumstances have they been seen to make a long-sustained flight such as would carry them from one orchard to another, and unless they are disturbed

by the wind, or other agency, they do not seem to pass readily from one tree to another. In fact, their normal mode of progression is by walking, and their wings are seldom used except to enable them to escape from a pursuer or to regain a tree from which they have fallen. As is the case with many plant-feeding bugs they are "cannibals," and readily attack each other (and probably other insects also). In captivity it is difficult for this reason to keep more than one alive in each cage. Pairing takes place soon after the bugs are mature, eggs are laid, and the cycle is completed.

The life history and habits of *O. marginalis* seem to correspond very closely with those of *P. rugicollis*, but observations tend to show that it is, on the whole, a later species. Adult examples of each may be caught together, but the majority of the *Orthotylus* would seem to become mature 7 to 14 days after the majority of the *Plesiocoris*. This point may be of considerable practical importance in orchards where both species occur.

Distribution and Food Plants.—These subjects may conveniently be taken together. Both *Plesiocoris rugicollis* and *Orthotylus marginalis* are natives of these islands and are widely distributed; in fact they would seem to occur commonly in almost every English county. It is notable, however, that in the past they have been known to entomologists as feeders on willow and sallow, to a less degree on alder and hazel, and the records showing their wide distribution almost all relate to the two former plants. Apple as a food-plant seems to have been practically unknown, and it is, perhaps, permissible to suggest that the bugs have, within comparatively recent times, accommodated themselves to a fresh food-plant. At this point it may also be mentioned that both species, but especially *Plesiocoris*, will attack red currant and cause a marked spotting and yellowing of the leaves, but it is not known whether eggs are laid on this plant. The typical injury as regards apple is at present recorded from Cambridgshire, Suffolk, Kent, Sussex, Worcester, Hereford, Devon and Cornwall, but many orchards, even in the most affected districts, are clean. There is no possibility of preventing the spread of the insects, which already occur everywhere, and may even be found on willows closely adjacent to unaffected orchards. Further, no explanation can yet be offered as to why the bugs have attacked apples in certain orchards and neglected them in others. Attacked orchards have no common features either of soil or situation, and the only observation which

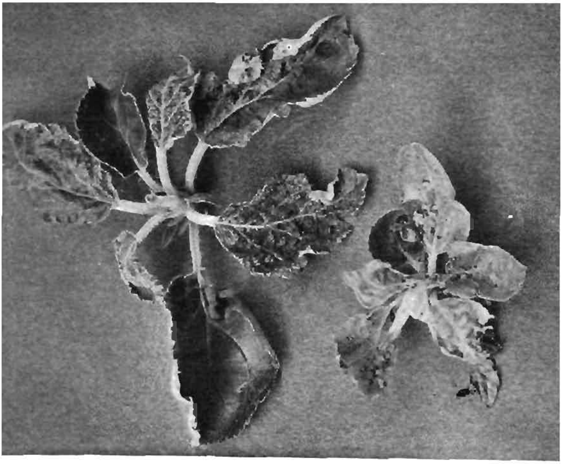
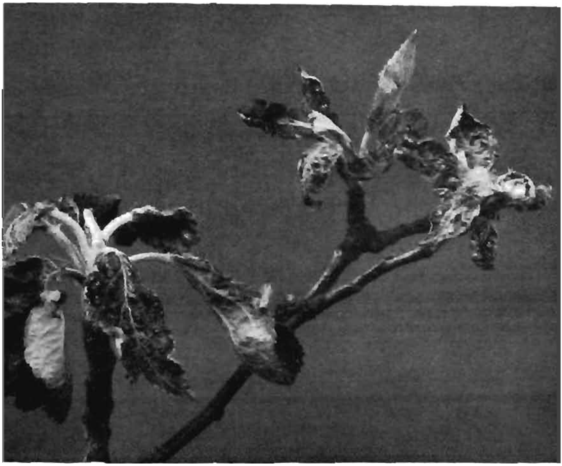


FIG. 3—Apple foliage attacked by Capsid Bugs.



R. A. Malby.

[illegible]

has been made is that they usually contain young trees. The possibility that an explanation might be found in the proximity of affected plantations to willows has been carefully considered. but no evidence whatever to support this hypothesis has been obtained. The whole subject forms a problem of a most unusual type. and it is, therefore, desirable that all statements concerning it should be made. and accepted, with the greatest reserve until overwhelming proof of their accuracy is obtained.

Control.—The preceding section will have shown the impossibility of yet suggesting any combined action among growers to prevent the spread of the Capsid " disease " which is present in a potential form everywhere. Similarly there are no known means of preventing the Capsids from including apple in their list of food-plants. It follows, therefore, that the insects must be tackled in each individual orchard as they appear.

Reverting to the life history, it is evident that the egg is efficiently protected, and the only method of treating the pest in this stage would be by means of a cover wash such as thick lime-wash applied sufficiently late to leave a coating over the twigs at the time when the insects should emerge. No full experiments in this direction have yet been recorded, though certain adverse opinions based on practical trials have been advanced. Such opinions, however, were not supported by observations as to the efficiency of the lime covering or the length of time it persisted, and before this class of treatment is finally dismissed further experiments seem desirable.

After the eggs have hatched there is no doubt that the sooner the bugs are attacked the better, for when young they are more easily killed, and have had less time in which to cause injury. The method must, of course, be by spraying, and observations suggest that the work must be done during the last 10 to 14 days in April, or possibly in the first week in May, the exact time varying with the locality and the variety of apple attacked. Certain growers consider that even as early as this the bugs are likely to be knocked off the tree without being killed, and they, therefore, renovate the winter-moth bands to prevent them from climbing back again. Many bugs undoubtedly escape in this manner when the spray is applied later, but further observations are required to confirm this possibility in the case of the newly hatched bugs.

The spray fluids which have given the best results up to the present are nicotine and soap and certain proprietary insec-

ticides containing nicotine or other vegetable extracts. In the case of the similar Capsid attacks in America, Black Leaf 40 (nicotine sulphate) has been found by far the most effective spray fluid, and has, in fact, afforded a satisfactory means of control.

Unfortunately, nicotine and similar insecticides are expensive, and though, in spite of this, they are extensively used, a tendency has been noticed to economise by sprinkling the trees with a light, misty spray. This is altogether false economy, for the bugs must be thoroughly wetted if they are to be killed, and a light application is, in many respects, money thrown away. If the destruction of Capsids is not considered sufficient to justify the heavy expense it must also be remembered that other serious pests are being killed at the same time.

This suggestion as to the use of nicotine in the first place must not be taken to preclude the testing of other contact insecticides, some of which may well be found as efficient.

The above remarks apply primarily to spraying before the blossom has opened. The question remains as to what may be attempted after the fruit has set. The bugs will then have grown considerably, and will be very apt to fall or jump from the trees if disturbed. It would seem probable that the use of winter-moth bands at this period is necessary if good results are to be obtained. If this is the case it is doubtful whether an expensive insecticide can be justified, and the cheaper washes, possibly even water alone, if applied through a coarse nozzle with sufficient force, may well be found to give as good results.

When, however, the period between the hatching of the bugs and opening of the blossom is sufficiently long, an attempt should certainly be made to control the bugs at the earlier period, and, in conclusion, it may be permissible to emphasise the suggestion already given as to spraying thoroughly.

It is better in the case of a pest of this nature to drench the trees with a more dilute or less efficient wash rather than to sprinkle them lightly with the best insecticide known.

THE IMPROVEMENT OF ALLOTMENTS.

THE value of allotments in adding to the supply of home-grown food is apt to be under-estimated. In the aggregate the land occupied by allotments must be very large, and, although the area is relatively small compared with the total cultivated land, it is for the most part cultivated on intensive

lines, and the average yield is probably considerably higher than that of ordinary arable land. There are, however, marked inequalities in the management and results obtained. At one extreme there are allotments, chiefly in industrial districts, which are thoroughly cultivated, liberally manured and intelligently cropped on the most intensive lines, and which yield crops equal to those of the best market garden land. At the other extreme there are allotments, particularly in rural areas, which produce barely as much as the neighbouring arable farm land; these are roughly cultivated, scantily manured, and cropped with little method or foresight, the standard being very low. It is not to be expected that the highest standard can be attained in all cases, for many allotments are on waste or badly-drained land, or are otherwise unsuitable. Even so, there is undoubtedly room in many cases for considerable improvement if the land is to be used to the best advantage.

With the object of obtaining some reliable information as to the conditions at present obtaining in regard to allotments, and as to the possibilities of improvement, the Board of Agriculture and Fisheries recently asked the Inspectors attached to their Horticulture Branch to make reports on the allotments they visited. A number of reports have now been received, and in view of their interest to allotment holders generally the Board think it may be useful to give a summary of the most important points.

Rural and Urban Allotments.—The reports all agree that on the whole the standard of cultivation is very much lower in the case of rural allotments than in the case of urban allotments. To a large extent this is due to different circumstances and motives. For the agricultural labourer the allotment is merely a continuation of his daily work: he has little spare time, and the work does not appeal to him as a recreation. In many instances he can grow all the vegetables he requires in his own garden, and, as there is little demand for the surplus vegetable produce, he finds it more profitable to grow the ordinary farm crops.

On the other hand the industrial worker has more leisure, he earns better wages, and is in a position to spend more money in purchasing good seed and other requisites. The work appeals to him as a recreation which is none the less attractive because it is remunerative. His enthusiasm helps him quickly to overcome initial difficulties, and his interest is maintained by

co-operation and competition. In time he often develops great skill; many of the exhibitors at shows in South Staffordshire, for instance, raise their own strain of flowers.

Size and Rent.—Both the size and rent of allotments were found to vary widely. In some districts, *e.g.*, in South Warwickshire, allotments are used as the main source of livelihood of the holder, and vary in size from ¼ acre to 5 acres.

In agricultural districts the size varies from ¼ to 1 acre, and the rent usually runs to from £1 10*s.* to £2 10*s.* per acre; frequently one man holds several allotments.

In urban districts the allotments are much smaller, usually only about one-tenth or one-eighth of an acre. The rent charged is seldom less than 1*s.* per 100 square yards, *i.e.*, £2 8*s.* per acre; in many cases it is at the rate of ½*d.* per square yard, or £10 per acre. An average rent is 1*s.* per rod, or £8 per acre.

The low rents of allotments in rural areas are often counterbalanced by losses from the depredations of game, although it should be added that urban allotments are more subject to pilfering. Allotments were found in the most unlikely positions; in South Wales, for example, the miners' allotments are made on the mountain sides, and in some boroughs on old rubbish tips.

Cultivation and Cropping.—Examples of good and bad systems of management were found in all districts: on the whole, however, as already pointed out, the standard was very much higher in urban than in rural districts. Inspection of many urban allotments showed from 80 to 90 per cent. to be well cultivated, while in the rural allotments visited the percentage of good allotments was frequently not more than 20 to 30.

In agricultural areas the allotment holders are mainly agricultural labourers who have little leisure, and little inclination to adopt systems of cropping requiring continuous attention; frequently they are content with the rotation practised on the neighbouring farms. The cultivation is often rough and ready, and horse labour is used. On both rural and urban allotments it is not uncommon to find allotments planted with a quantity of one vegetable only, little attempt being made to secure a succession. In many allotments the greater part of the ground is left vacant from the time late potatoes are lifted until about Good Friday, and the tendency to plant the whole allotment at once to avoid further trouble is very marked.

On the other hand the management of many urban allotments is excellent; there is evidence of greater forethought and method, resulting in a larger variety and more continuous supply of vegetables, fruit and flowers; in some cases small greenhouses and cold frames are erected. In some instances successful attempts had been made to sell the surplus crops locally. At Templenewsam (W.R. of Yorkshire), for instance, where there are 60 or 70 allotment holders of the artisan class, the children are sent round the district to dispose of surplus vegetables and flowers. The crops show much greater variety than usual, each occupant competing with his neighbours in growing the vegetables and flowers for which there is the greatest local demand.

Competitions.—Unless there happens to be a large number of allotments in the district the horticultural section of the annual village agricultural and flower show is apt to be rather limited. In industrial districts where Allotment Associations have been formed, it has been found, however, that the shows are better adapted to meet the requirements of the members. In some districts monthly and even fortnightly shows are held during the summer. Competitions are probably of greatest value when the crops are judged on the allotment itself, as in such cases the occupiers almost invariably work their ground well and keep it clean. An example of this form of competition was found at Lower Bebbington, Cheshire, where prizes are given for the best cultivated and cropped gardens, it being essential that each garden should have a flower border of a certain area. The prizes given at these local shows are generally small, but the allotment holders enter into the competitive spirit and neither time nor labour is spared to obtain the prize. Competitions are of service in keeping alive the enthusiasm of the allotment holder and in encouraging good cultivation. It was frequently remarked that where shows were discontinued the general treatment of the allotment deteriorated almost at once.

Co-operation.—In agricultural areas little attempt seems to have been made to work on co-operative lines. In urban districts, on the other hand, Allotment Associations or Garden Protection Associations were frequently met with. The value of these associations is evident in the enthusiasm and keenness of the members and in the general high standard of cultivation of the allotments. The associations prove of great assistance to the members by purchasing their requirements co-operatively. Manures and lime, for instance, are bought in bulk; pea and

bean sticks are bought by the load; seeds are often obtained from the best seedsmen, and distributed at practically cost price. The associations are in a better position than the individual to approach district councils and landlords when more land is required for allotments. They can also arrange meetings, lectures and demonstrations on horticultural subjects for the benefit of the members.

A good example of what may be done by confiding the management of the allotments to a committee is given by the Trinity Horticultural Society, Carlisle. The society appoints a committee of management which is made responsible for collecting rents, for organising the annual show, and for ensuring the proper cultivation of the gardens. If an allotment holder appears to be neglecting his plot, allows weeds to flourish, and fails to trench to a certain depth in the autumn or winter, he has to appear at the annual meeting, and show if there is any reasonable excuse for the neglected condition of the plot. The result of this action is that the allotments are very thoroughly cultivated. A few of the plots are largely planted with potatoes, but on the majority there is an excellent variety of vegetables.

Another example is that of the Chesterton Allotment Society, Cambridge. This society hires 54 acres at a rent of £178 a year and lets to 460 allotment holders, who are all members of the society. A committee room has been provided on the land, and almost every tenant has put up a tool house which is unusually neatly built. The society buys seeds as well as Scotch-grown potatoes for its members. Twelve of the members keep pigs, the sties being arranged together on the boundary.

Suggestions for Improvements.—In conclusion it may be useful to indicate briefly the directions in which improvements may most readily be made :—

Manuring.—Where artificial manures can be obtained at a reasonable price, *e.g.*, co-operatively, they should be used more extensively than at present. The manure applied to allotments in the past has been almost entirely in the form of animal manures, and in most cases small applications of artificial manures, especially phosphates and potash (if available), would improve the quality and add to the yield of the produce. Lime could also be used more freely with advantage.

Cropping.—Many allotments might be cropped on more intensive lines. Provided the land is deeply cultivated and liberally manured, two or even three crops may be taken

during the year. Where there is likely to be any large quantity of surplus produce, crops and varieties should be grown which are in demand locally.

More systematic efforts should be made to prevent the outbreak of disease, *e.g.*, in districts where wart disease is prevalent disease-resistant types of potatoes should be used for "seed." Lime should be applied to prevent "finger-and-toe" in turnips, cabbages, etc.

Competitions.—Greater prominence should be given to competitions. Apart from the merits of the produce the general appearance and cultivation of the allotments should be taken into consideration in awarding the prizes.

Co-operation.—Any considerable improvement is largely dependent upon the possibility of adopting co-operative methods, and allotment associations or societies should be formed wherever possible. If an association is not feasible, the allotment holders should at least endeavour to combine in purchasing seeds, manures, etc., in bulk.

Instruction.—Associations, and parish and other local authorities owning allotments, should encourage allotment holders, by arranging lectures, demonstrations, etc.

THE CROYDON VACANT LANDS CULTIVATION SOCIETY.

MISS E. L. HUDSON,

Hon. Secretary of the Society.

> "He gave it for his opinion, that whoever could make two ears of corn, or two blades of grass, to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together." *Swift.*

Origin.—In 1908 the Croydon Guild of Help formulated a scheme for the cultivation of vacant lands, but owing to insufficient support this scheme fell through. The subject was revived at the outbreak of war by an offer made by a well-known Croydon landowner to lend his vacant plots for cultivation, free of rent, to any applicants. This gentleman also promised to compensate cultivators for loss of crops should he desire to take over his land again at short notice. Although the soil was only fair, and the land in some parts extremely rough, about 20 applications were received. The prime mover of the original Committee then called together persons likely

to be interested in the scheme, and a meeting was held on 23rd September, 1914, at which the Committee of the new Society was elected. It included, among others, two well-known landowners, a solicitor and four representatives of the chief local horticultural society. Another landowner offered his vacant land, and others were approached by members of the Committee, with the result that the Society had in December, 1915, control of about 20 acres, lent by 22 different owners, and lent in small plots of 12 rods or less to over 260 cultivators.

Croydon.—Croydon is a town of 181,000 inhabitants, 10 miles from the centre of London, residential and suburban in character, but there is also a very large wage-earning population. Its area is 14 square miles. The building trade has been declining for some years and there are many unoccupied houses.

Rules and Regulations.—The Committee formally constituted itself, appointed the usual officers and framed rules, similar to those of other Vacant Land Cultivation Societies in London, Dublin and Birmingham, but differing in one important particular, namely, that the Croydon plot-holders became full members, paying a minimum subscription of 4s. a year, earmarked for the compensation fund. The importance of this fund is apparent, for the Committee fully realise that, although the plots are only lent to the plot-holders, it is not certain that they escape the provisions of the various Acts governing small holdings and allotments, under which the Society could not contract out of liability for compensation.

Regulations for plot-holders are printed on the back of the application forms, so that the men understand the conditions of tenure from the first. This paper is returned to the plot-holder with a copy of his agreement. Besides the usual rules for allotment holders, providing that the plots shall be cropped to the satisfaction of the Committee, the cultivator has to sign an undertaking that he will give up his plot on demand. The agreement is signed over a 6*d*. stamp, provided by the plot-holder, so that in case of any dispute it may have legal value.

Appeals for Land.—By the courtesy of several estate agents in providing the names and addresses of owners of vacant plots, and by diligent local inquiries, the Society was able to send out a large number of appeals for vacant land, to many of which of course no answer was received. Favourable replies were, however, received from 15 private owners and 3 land companies, as well as from the Trustees of the Whitgift Foundation and the Croydon Corporation. The latter, with their usual public

spirit, have remitted rates, afforded privileges in the use of water, and helped the Society in various other ways.

An agreement is signed by the landowners and the Committee (acting through one member appointed as their agent), so that in the event of any trouble with tenants the Committee personally are responsible. In most of the agreements the Committee undertake to vacate the land after 4 days' written notice.

Garden Committee.—To carry out the work of the Society effectively it was found necessary to form a Garden Sub-Committee to undertake such external work as inspecting the land offered, marking it out, letting it to applicants, superintending the plots, advising on the cultivation of crops, and other details. The members of the sub-committee are exceptionally fortunate in their chairman, a practical gardener, who has thrown himself wholeheartedly into the work, and given much sympathetic and valuable advice to the plot-holders.

The Committee originally made their existence known by placing temporary notices on the vacant plots, but this soon became unnecessary, for numerous applications were received, till at the end of December, 1915, there was a waiting list of 150 names.

The plots lent vary in size according to the nature of the land, but are usually of about 10 rods. Sub-letting is strictly forbidden, and if it occurs each tenant is made to sign the agreement direct with the Committee, and pay the full subscription, though only retaining part of the plot. The land cultivated consists mainly of building plots, but in three cases the gardens of houses have been used.

Fencing.—The question of fencing proved a difficulty, and was met by a decision of the Committee that all improvements such as fencing, laying on water, etc., must be effected by the plot-holders themselves working co-operatively.

Yield of Plots.—The following quotation is from one of the monthly reports (September, 1915), of the Garden Committee: "The plots are receiving good cultivation in each instance. Where the tenancy began last autumn, the cultivator is now getting good returns for his labour. Some excellent early crops have been gathered, and the ground, after being properly treated, has been replanted. Other grounds let at a later date have been well trenched, and are mostly cropped with vegetables which will yield produce in the coming winter and early spring.

Neatness and tidy appearance are found on each plot, and it is a pleasure to walk round these grounds and observe the welcome change made in a few months from a barren wilderness to a productive piece of land."

The following are particulars of crops either wholly or partly gathered at the end of 1915 on a plot of 9 rods, part of a building site lying idle for several years, which has only been under cultivation since the end of April last :—

	s.	d.	£	s.	d.
Crops gathered.					
6½ bush. potatoes, at 3*s*. 0*d*. per bush.				19	6
10 ,, ,, ,, 2*s*. 6*d*. ,, ...			1	5	0
45 lb. runner beans, at 1*d*. per lb.				3	9
2½ doz. lettuces, at 1*s*. per doz.				2	6
1 bush. turnips				4	0
1 doz. vegetable marrows, at 1*s*. per doz.				1	0
Crops partly gathered and partly remaining on ground.					
3 rows (40 plants each row) leeks, at 6 stems for 2*d*.				3	4
34 rows (26 plants in each row) greens, including Brussels sprouts, broccoli (heading and sprouting) cauliflowers, cabbages, kales, savoys, totalling 884 plants at 1*d*.			3	13	8
Total			£6	12	9
Expenditure.					
Seeds and plants	11	0			
Manure	2	6			
				13	6
Estimated total profit on 9 rods of ground, May, 1915, to March, 1916			£5	19	3

Rather than overestimate the returns the value of each crop is placed at a nominal figure. The estimated profit includes return for labour.

On 5 rods of land, so poor that it was almost refused, a plot-holder produced an excellent crop of 5½ cwt. of potatoes.

Regarding another plot of 10 rods the plot-holder writes (December) that about 15 cwt. of vegetables have been gathered in 1915 : "200 spring cabbages, 100 cauliflowers, 1 row of broad beans, 2 rows of runner beans, 1 bed of shalots, 1 bed of turnips, 1 bed of beet, 2 rows of parsnips, 1 bed of onions, 1 bed of shorthorn carrots, 3 rows of intermediate carrots, 1 bed of vegetable marrows, 3 beds of lettuces, several crops of radishes, 24 lb. of tomatoes, and 18 bush. of potatoes. The ground is now well cropped with winter things, such as Brussels sprouts, savoys, broccoli and curly kale. Enough vegetables have been grown on this plot to keep my wife and family through the winter."

Branches.—Branches have recently been formed in two adjoining districts, Purley and Wallington, where some 50 plots have been started, and enquiries have been received from other parts.

Objections.—An objection has been raised to the work of the Society that already there is often an over-production of vegetables. From the point of view of the plot-holder, one obvious answer to this is that, no matter how cheap vegetables may be, whatever he saves by growing them is so much gain to him as a result of a healthy spare time occupation. From the point of view of the nation, if there should be real over-production of vegetables it points the way for the transference to more general farming of some of the least suitable market garden land, which is merely a matter for better industrial organisation

Goodwill of Landowners.—The scheme outlined rests entirely on the goodwill of landowners; it is therefore absolutely necessary to interest them, to conciliate them, and to render them free from any responsibility with regard to compensation.

Compensation.—For those who may wish to start the cultivation of vacant lands in any locality, the main points to consider are organisation, finance and compensation. Taking the last-named first, it may be said that outside the Metropolis, compensation is payable (1) for crops, including fruit, growing in the ordinary course of cultivation; (2) for labour expended upon the holding and for manure applied to it since the taking of the last crop therefrom, in anticipation of a future crop, and (3) for certain other improvements if executed with the written consent of the landlord; such compensation is payable in cases where the Allotments and Cottage Gardens Compensation for Crops Act, 1887, applies, notwithstanding any agreement to the contrary, and irrespective of the length of tenancy. The Act does not apply unless there is a tenancy, but a tenancy may be created although the land is let rent free.

In order to meet objection by landowners to incurring a liability for the payment of compensation, it may in some cases be desirable to avoid the creation of a tenancy, and to accept from a landowner only a terminable licence to enter and cultivate the plots for a specified purpose, in which case compensation could not be claimed by the licensee under the Act referred to, as he would not be a tenant. But as in many cases the vacation of the land on short notice is an essential part of the arrangement, a scheme is not likely to succeed unless the Society can make some provision for compensating occupiers who lose their land.

Organisation and Finance.—Since the plot-holders' subscriptions are earmarked for the compensation fund, and thus form an insurance against loss of crops, the Society is entirely dependent on subscribing members for its working expenses, and local sympathisers have been asked to contribute. The Committee did, however, make 30*s*. by the sale of fruit from an orchard. Owing to the number of honorary services rendered, the expenses have been kept low, and in 15 months have not reached the sum of £9.

Concerning organisation and finance generally, in the case of the London Society these points were made easy by the generosity of the late Mr. Joseph Fels. In Croydon the public spirit of the Guild of Help and the members of the Garden Committee made the task also comparatively easy. Quite recently, however, tentative enquiries were made from a suburban area, where the conditions appear to be less fortunate, and it is a question of real difficulty to see how these two points can be met. With the appointment of the Parliamentary War Savings Committee, however, the way seems to open up for bringing people in such areas together, and giving a lead which will enable them to overcome the initial difficulties attendant on the inauguration of any movement of a novel kind. It may be advisable later to form the Croydon Society into a Society registered under the Industrial and Provident Societies Act, 1893, and if the scheme for the cultivation of vacant land becomes popular, it will be a question for consideration whether model rules cannot be drawn up to enable registration to be efficiently, quickly and cheaply carried out.

The Croydon Society are prepared to give the benefit of their short experience to further any movement in this direction.

CALICO POULTRY-HOUSES.

LIEUT.-COLONEL P. H. FALKNER.

CALICO was first used by the writer as a material for constructing poultry-houses when stationed in Bermuda some six or seven years ago. The price of wood in the Island was at the time almost prohibitive, and it was in an endeavour to find an economical substitute that he conceived the idea of using calico stretched over a light framework of wood. Since then calico poultry-houses have been erected by poultry-keepers in many other parts of the world. Even in this country, where a substantially built house is usually considered necessary to withstand the varying climatic conditions, this type of house, when well constructed, has proved satisfactory and has compared favourably with houses constructed of wood. From his own experience and that of other poultry-keepers who have tried them, the writer has no hesitation in saying that calico houses will provide sufficient protection in the coldest weather, and that all kinds of birds, from day-old chicks to laying hens, will thrive when kept in them.

Owing partly to the fact that the idea has been only comparatively recently introduced and that, therefore, the majority of poultry-keepers are still unfamiliar with the possibilities of this economical substitute for wood, and partly to a not unnatural hesitation in making use of what at first sight appears to be hardly a suitable material for the purpose, calico poultry-houses have not as yet been extensively used in this country. The present price of timber, however, should provide an incentive to poultry-keepers to test their merits. They should especially appeal to the small poultry-keeper who, owing to lack of means, has frequently to content himself with a makeshift house. By substituting calico for part of the wood as indicated below he may expect to provide accommodation for his fowls at less cost and yet obtain results which compare favourably with those obtained where houses are built entirely of wood.

The house described in this article is 6 ft. by 6 ft. in size. It includes laying quarters for the hens, and, in designing it, the provision of a water supply, suitable shading arrangements, and the convenience of the attendant have been considered. Under intensive conditions the house will accommodate from 12 to 15 general-purpose fowls, or as many as 20 Leghorns, but better results will be obtained with three-fourths of this number. The house is equally suitable for

use in an enclosed grass run, or when the poultry are kept on a free range. The cost of erection will probably be about 30*s*. to 35*s*.

Construction.

The various steps in the construction of the house are best followed by frequent reference to the illustrations. To facilitate this the instructions are given in the form of explanatory notes on each figure.

Figure I. (*Floor and Trestles*).—The first step is to make a floor frame, 6 ft. square, of 1-in. by 9-in. planed timber. To this frame is fixed a floor, made up of $\frac{7}{8}$-in. or 1-in. matching.

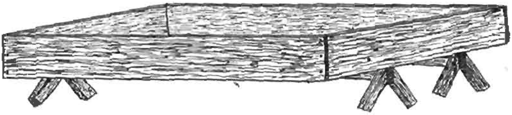


FIG. 1.

Two trestles, each 6 ft. 2 in. long, are then fixed to the under side of the floor boards to raise the frame off the ground and permit of a free circulation of air under the house.

Figure 2. (*The Body of the House*).—The body consists of four frames made of $\frac{7}{8}$-in. by 3-in. slatting joined together as illustrated (Fig. 2B). Each side of the frame should be 19 in. high (Fig. 2A) and as long as the floor frame board, upon the upper edge of which it will rest when the sections are joined together.

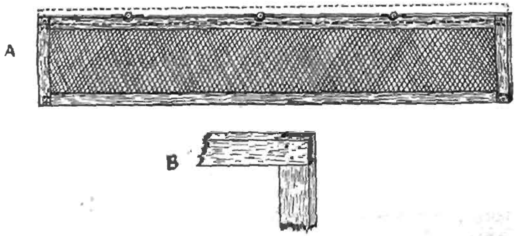


FIG. 2.

To the upper edges of the two frames destined for the back and front, $\frac{3}{4}$-in. sash-rollers are fitted, three on each as

illustrated (Fig. 2A), and a strip of ⅜-in. matching is nailed to the outside of their top bars, as shown by the dotted line in the diagram. The rollers and side cleats are omitted from the two end frames.

To the frame destined to form the front of the house, 1-in. mesh wire netting 12 in. wide is fitted. The remaining frames are covered with calico and reinforced with wire netting.

Figures 3 *and* 4.—The four body frames are fitted to the floor frame as indicated in Fig. 3. They are fastened to the floor by means of a 4-in. nail passing through the bottom bar of a side frame into the floor frame edge, and a staple made by bending a headless 4-in. nail and applied between the sections as indicated in Fig. 4.

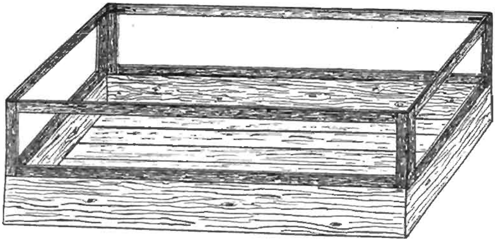


FIG. 3.

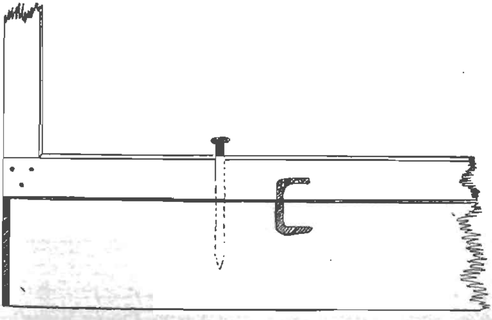


FIG. 4.

Two each of these will be required for each side. A light nail may be used at each corner of the body to hold the frames together until the four inside top corner brackets are fitted.

Figure 5. (*Roof Frame*).—The roof frame is made from *four strips of $\frac{7}{8}$-in. by 3-in. slatting placed edgewise.* It should be laid upon the six rollers between the side cleats to ensure that it exactly corresponds to the upper edge of the body of the house and moves freely from right to left. If satisfactory in this respect the four corner pieces of $\frac{3}{4}$-in. matchboard are applied across the angles as shown, each being cut off flush with the frame's upper edges.

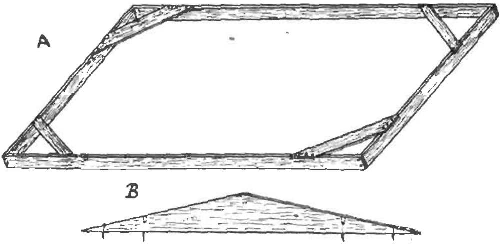


FIG. 5.

Two gable pieces made from $\frac{3}{4}$-in. matching (Fig. 5B) and measuring 5 in. from apex to base, are then nailed one to each end of the roof frame.

Figure 6. (*Roof Side Frames*).—The two roof side frames are made from $\frac{7}{8}$-in. by 3-in. slatting, and are large enough to allow for an overhang of at least 4 in. upon all sides of the house when hinged together (Fig. 6A). The frames are then placed in position, where they will be supported by the angle pieces apparent in the diagram (Fig. 6A).

The topmost edges of the roof side frames must now be bevelled so that they will come together accurately to take the two hinges which hold them together (Fig. 6B). A strip of $\frac{3}{4}$-in. matchboard is next nailed to the upper surface of each frame midway between its top and bottom bars; and across this centre piece a series of $\frac{1}{8}$-in. plaster laths, 3 in. one from another, are tacked (Fig. 6A).

The back half of the roof is fixed to the house with four screws, two above, where the top bar takes the gable ends, and two below, where the angle pieces rest on the roof frame. In this manner the front half of the roof can be opened or closed according to weather conditions.

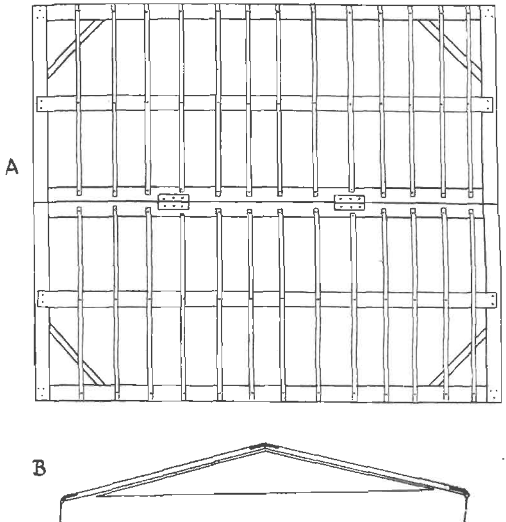


FIG. 6.

A hook is fixed to the centre of the roof's free edge on each side (Fig. 6B). The corresponding eyes for the two hooks should be conveniently placed on the body of the house to secure the roof by night and during storms.

Figure 7. (*How to Fit the Calico*).—Three lengths of unbleached calico at 2¾*d.* per yard are then taken, sewn together, selvedge to selvedge, and placed across the coop, so that the material is continuous over the dotted hinge line. The calico is pulled fairly taut over the roof frames and attached, preferably by means of copper tacks, to the free outer edges of the roof. It is best to roll the cloth at this point to form a kind of cushion for the tacks to pass through and thus take a firm hold.

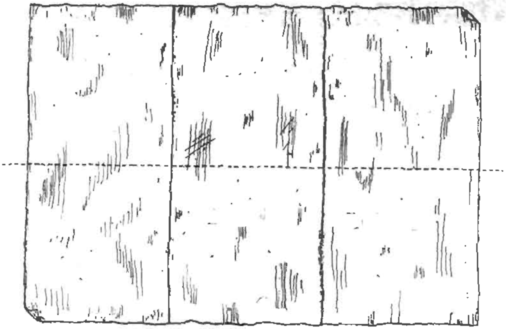


FIG. 7.

A separate strip of calico, fitted to the under surface of each frame, will form a double-ply roof, and the intervening dead air space will prevent condensation of moisture and retain the heat.

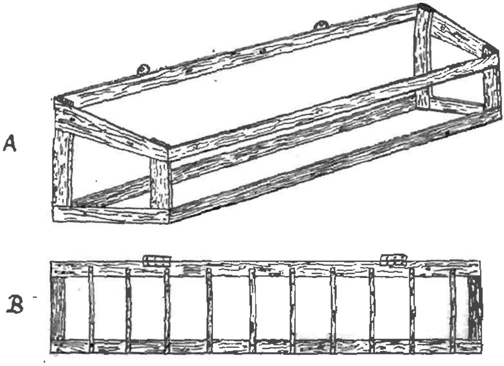


FIG. 8.

Figures 8 *and* 9. (*Nest Boxes*).—The nest box consists of four uprights $\frac{7}{8}$ in. by 2 in., the remainder of the frame being made from $\frac{3}{4}$-in. matching, as indicated in the diagram.

The framework of its roof is completed with plaster laths, and should overhang sufficiently on three sides to carry off the rain water. The upper edge of the coop lid is hinged to the highest matchboard bar of the nest box framework. The box is then suspended to the outside and back of the coop (Fig. 9) by means of two perforated brass plates and screws fastened to its top bar. One small opening is made between this single compartment laying quarter and the coop itself.

The front and upper opening of the coop, underneath the adjustable part of its roof, is now covered in with 1-in. mesh wire netting (Fig. 9). This is best accomplished by arranging a few cross wire supports, as illustrated, over which the netting is fitted by tacking its edges to the gable ends and side bar of the roof frame. Two or three short strands of wire, passed through holes in the nearest wood of the fixed roof section, will probably be necessary to prevent the net from sagging beneath the hinge line.

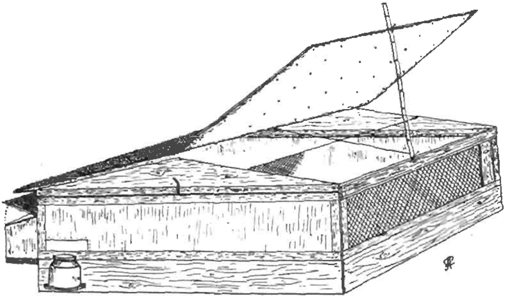


FIG. 9.

Fig. 9 also shows an empty 7-lb. jam jar placed on an outside platform. Two or even three such water fountains may be necessary; but if arranged according to the diagram, with two light pieces of wood nailed together like the letter L, to leave an opening through which the fowls can reach, they will be found very convenient.

The small trap-door shown at one end of the wire-covered front provides an exit for the birds when this is desirable. No perches are used; the poultry are safe and clean upon the dry litter to which they become accustomed in due course.

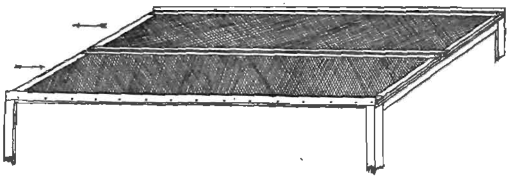


FIG. 10.

Figures 10, 11, *and* 12.—Fig. 10 shows the top of a house with the sliding roof lifted off its rollers, while Fig. 11

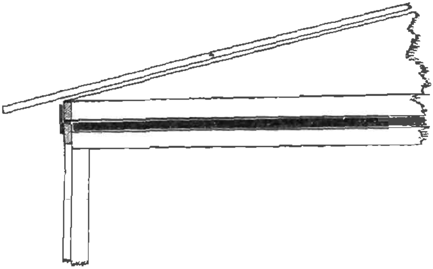


FIG. 11.

illustrates the manner of dropping the end frames of the body, to afford room for the new fitment (shaded). With this plan, instead of the more simple one illustrated in Fig. 9, it is possible to obtain access to the interior of the house without sliding the main roof, and the birds are under perfect control.

FIG. 12.

Fig. 12 represents a light poultry hook invaluable for handling stock when in the house.

Weatherproof Calico.

To render the calico weatherproof a mixture of 1 lb. of tallow candles and 1 gal. of stockholm tar heated together should be applied and allowed to remain for twenty four hours. Two or three coats of coal tar and sand or fine anthracite coal ashes should then be applied.

For the sides two coats of the stockholm tar mixture are all that is necessary; and the woodwork throughout may be likewise treated with excellent results.

Alternative Methods.

If desired the following mixtures may be applied instead of the above :—

(*a*) The entire calico—except that of the nest box, which should always be made impervious to light—may be rendered waterproof and translucent with two coats of boiled linseed oil, to every quart of which is added one teaspoonful of terebene (dryers).

(*b*) One half-pint of goldbeaters' size to each gallon of boiled oil also makes a satisfactory and translucent proofing solution.

(*c*) The " Berthon " method.

Dissolve 6 oz. of common soap in 1½ pt. of water. While boiling add 5 lb. of boiled linseed oil, ½ lb. litharge, and 5 lb. of ochre spruce. Apply when hot, and remember several thin coats are better than one quickly applied.

WASTE WOODLAND FOR THE BREEDING OF PIGS.

S. F. EDGE.

THERE are on the writer's farm about 100 acres of woodland, consisting chiefly of oak and an undergrowth of hazel. This woodland being practically valueless as such, except as shelter for game and vermin, the hazel was cut down over a considerable area, and during January and the early spring this portion was used for incubator-hatched chickens, as it was found that they did much better under such conditions than when running on grass. It is now a fine sight in the early months of the year to see the lines of warm brooders and thousands of chicks occupying the area.

This arrangement, however, still left the woods unused for some months in the year. Becoming dissatisfied with the sty and usual housing methods for breeding pigs, which did not appear to allow of sufficient pleasant sunshine for young and growing animals, the writer decided, much against the wish of the pigman, to experiment with an out-door life for pigs. The first experiment started a few years ago in September with 24 gilts of about 3 months old. These were divided into two

lots, 12 being placed in the usual pig sties, while 12 occupied at will two wooden huts, each 8 ft. by 8 ft., standing in about 4 acres of woodland, enclosed by a wire fence. The wooden huts were placed on railway sleepers so that the pigs could always retire to a good, dry bed. An opening, 3 in. wide, was provided along the ridge of the hut for purposes of ventilation, and the entrance-door was made in two halves, the upper half being kept shut in cold weather and the lower one always open.

The piece of woodland enclosed consisted of small oak trees and hazel bushes, with a considerable growth of rough grass and weeds. Very few acorns or nuts were to be found when the pigs were turned in, and hence they were fed twice daily with 3 lb. of sharps per head, or an equivalent weight of peas or beans was scattered about to be searched for. In a few weeks the pigs had turned over the whole area, and dragged out and eaten most of the weeds and coarse grass roots. The winter was very wet, and, as the ground is weald clay, the pigs trampled the bulk of it into deep mud, though without any detriment to health. They were, therefore, allowed to remain, as it was obvious that they were in better health and condition than the pigs in the brick buildings.

During March the pigs began to eat the hazel when it showed signs of shooting; they had already eaten all the small blackberry leaves and runners. It was then decided to give 3 lb. of mangolds per head daily, in addition to the sharps, and this continued until the middle of April, when the "woodland" pigs were compared with the lot that had been similarly fed in brick sties with only daily exercise on pasture or road. The total weight of the 12 that had lived out was 11 per cent. higher than that of the others, and, individually, they looked much better and stronger. When the time came for farrowing, the out-door pigs still showed advantages: they were better mothers, they did not lie on their young (being muscularly stronger and more active), and they maintained condition better; in fact, all through their breeding period they were noticeably stronger in constitution and able to assimilate their food with better results.

In view of the results of this experiment, the open-air system has been gradually extended, and during 1915 nearly all the sows were farrowed out in wooden sheds or shelters. These are provided with wet-proof roofs, the sides being made of hazel faggots.

Sows Grazing Ground—Woodland and Pasture.

Middle White Pigs in Orchard.

(The Board are indebted to Messrs. Charles D. Clayton, 52, Shaftesbury Avenue, London, W., for the loan of the blocks of the above illustrations.)

At 3 days old the little pigs begin to run about outside their huts, and it is most rare to have either a sick pig or one overlain by the sow.

The general plan is simple in the extreme, every little odd corner or piece of useless or waste ground, from half an acre upwards, being fenced in and provided with a farrowing hut. Here the sow and litter remain until weaning time, which, in the case of pedigree stock, is generally when the pigs are 10 weeks old, specially good growth and size being all-important.

When the pigs are weaned they are removed to larger enclosures (5 to 20 acres) in the woods, and are left in lots of 30 to 40 pigs. After a week or two any that do not seem good enough for pedigree purposes are put into sties and fed for porkers of about 100 lb. live-weight, for sale between September and April. If this is impracticable they are kept on for bacon pigs of about 220 lb. live-weight.

In regard to the pigs kept for pedigree purposes, in another two weeks the boars are separated from the gilts, and from then onwards, until wanted for breeding or sale, they are kept in enclosed areas in the woodlands in lots of from 12 to 40, depending on size; as they get bigger the numbers kept together are reduced.

During this growing period the food consists of sharps, with one-third peas or beans from time to time when the pigs are over 4 months old.

At the periods when green-stuff is scarce in the woods, mangolds, cabbage and lucerne are given, but at no period, even with the present high values of feeding-stuffs, do even the largest boars or gilts get more than 3s. worth of food per head per week, the home-grown food being valued at the price for which it could be sold.

In regard to the treatment of the runs, these are rested three months out of the twelve; the smaller farrowing enclosures are limed once a year; and in those that are resting in the spring a little clover and rye-grass seed is sown. As the ground is enriched by the pig manure the crop grows quickly and luxuriantly.

During the winter all the larger gilts and sows from 12 months upwards are specially ringed and allowed to roam over the grass land. This is beneficial in two ways. The breeding pigs walk a lot in search of choice grasses, and at the same time pig manure is deposited all over the pasture. Being weald clay the land will not stand cattle or sheep in the winter, but pigs do no harm as they do not run thickly.

All the grass land has been mole drained and well slagged, with the result (presumably due to the pigs, the slag and the draining combined) that the grass is much more luxuriant than any other in the district. Best of all, there is a luxuriant growth of clover; in fact, in 1915, some fields looked more like fields of clover than ordinary grass fields. This same land, when bought 5 years ago, grew little else but weeds of various kinds, much of it, indeed, being so bad that the cattle would not eat it, and it was merely mowed for bedding in the yards. At present, there is not a square yard that is not growing good, deep grasses and clovers. On any thin places it was only necessary to scatter peas or beans, and the pigs made for these spots, and, owing to the extra manure thus provided, the thin places quickly showed an improvement. The net result of keeping pigs in the way described is:—

1. That breeding pigs are more prolific and much hardier than sty-bred pigs.

2. The simplicity and cheapness of the system, given the necessary waste woodland or poor pasture, make it commercially better than permanent housing.

3. The cost of housing, fencing, and apparatus is as follows:—

Wooden house, 8 ft. by 8 ft., bolted together in sections to facilitate moving, £6.

Eight old railway sleepers to stand house on and make floor, 12*s*.

Fencing wire, including posts, etc., 6*d*. per yd.

Home-made wooden troughs, 2*s*. 6*d*. each.

One 40-gal. barrel for soaking food, 5*s*. One barrel will provide for up to 40 pigs daily.

4. Against the pig accounts 5*s*. per acre is charged for waste woodland. No charge is made for pasture as the pigs run on this only from November to March when it is not in use for anything else except poultry, and the pig manure is considered a fair equivalent against rent. Straw, fern, or other bedding must be used from September to May.

5. The pedigree pigs are sold at a price representing not less than £1 1*s*. per month of their life, viz., a 6-months-old pig realises £6 6*s*., and so on. On an average most pigs are sold by the time they reach 6 months. Many are sold at much higher prices than those given, boars in particular, but against this must be set the fact that it seems much harder to breed really good boars than it does gilts, and, therefore, a much larger percentage of boar pigs go to the butcher than do gilts. The aim is to cull most drastically, and keep only the really

first-class pigs. The result of this was that in the first year or two only some 15 per cent. of the pigs were kept for pedigree sale, whereas at present 80 per cent. are fit to keep for breeding.

6. Another interesting and valuable feature is that pigs not good enough for pedigree sale, when put into sties to fatten for the butcher, put on weight for a given amount of food at least 20 per cent. more cheaply and more quickly than mongrel pigs. This was tested by feeding together mongrel and pedigree pigs, the result being that the pedigree pigs were ready for sale two to three weeks in advance of the mongrels when being fed to make bacon pigs.

With a view to spreading knowledge of the advantages of good pedigree pigs, consignments of about 3 doz. breeding gilts at a time have been sent to the local market, to be sold without reserve. This will continue so long as the pigs are bought by farmers or small holders for breeding purposes. The last consignment, sent off on 29th November, 1915, consisting of in-pig gilts, realised an average price of £15 for Large Blacks from 11 to 12 months old, and £7 6*s*. for Middle Whites from 7 to 8 months old. After considerable experimenting these two breeds, the Large Blacks and the Middle Whites, have been found the most successful.

MILK PRODUCTION IN WAR TIME.

FROM the point of view of the national health an adequate supply of milk is of fundamental importance. Besides being a complete food in itself, unequalled in respect of nutritive properties and digestibility, milk derives peculiar value from the fact that for its supply we are practically entirely dependent on home production. A steady demand for milk is thus assured so long as it can be put on the market at a reasonable price. It may be remarked that, from the standpoint of food value, milk is at present a considerably cheaper source of energy than beef.

The business of the milk producer, an anxious and arduous one at any time, is aggravated, at present, by the scarcity of labour and the abnormally high cost of feeding stuffs. For the most part, successful efforts have been made to meet the new situation, but in a few cases the difficulties appear to have been regarded as insurmountable, and milking herds have been reduced or dispersed. The labour difficulty is, no doubt, very real, but the present cost of feeding stuffs is apt sometimes to occupy undue prominence in the farmer's calculations.

The foundation of successful and economical milk production lies in home-grown foodstuffs—grass, hay, straw and roots—and so long as these are available at about normal cost, a fairly substantial rise in the price of concentrated feeding stuffs should make relatively little difference to the cost of milk production.

It may be interesting, in the light of present conditions, to examine the following dairy herd account (pp. 984 and 985) in respect of a herd of milch cows for the period of 12 months following the outbreak of war, viz., Michaelmas, 1914, to Michaelmas, 1915. The herd in question consists almost entirely of pure-bred British Holsteins, and belongs to Mr. Arthur S. Bowlby, of Gilston Park, Harlow, Essex, to whom the Board are indebted for the figures and information given in this article. Except for the occasional introduction of new blood, the herd is self-supporting. As will be seen from the statement of account, the herd, during the year under review, comprised 98 cows, a number of bulls for breeding purposes and for sale, the young stock necessary to keep the herd up to strength, &c. Surplus stock were sold as follows: 24 cows, 5 bulls, 25 heifers, and 49 calves. No fancy prices were obtained, the highest price for a cow being £28, and for a bull, £40. Heifers and calves realised ordinary commercial prices.

The whole of the milk, with the exception of 918 gal. supplied to the Jersey herd, was sold to London dealers at the rate of 9*d*. per gal. for the summer half-year, and 11*d*. per gal. for the winter period. The financial statement is therefore based on the actual receipts. Altogether, 98 cows produced milk during the year, but the average number in milk was 82. The total amount of milk *sold* during the year was 73,894 gal. This gives an average for the 98 cows of 754 gal. per cow, but takes no account of milk fed to calves for the first few days after birth. The total *value* of the milk *sold* was £3,041 6*s*. 8*d*. or at the rate of £31 0*s*. 8*d*. per cow. The balance to meet interest on capital, supervision, business and other expenses, and profit, was £1,380 5*s*., or £14 1*s*. 8*d*. per cow. The account has been debited with only three-fourths of the cost of the feeding stuffs at the farm; the balance represents the value of the manurial residue in accordance with local valuers' practice. Valuing on the basis of Voelcker and Hall's system, the position of the cows would be improved to the extent of about 9*s*. per head.

Mr. Bowlby started milk recording in 1909. His system is to record the yield of each cow, night and morning, once a

week. The following are the average yields per cow in the years during which records have been kept :—

	No. of Cows.	Yield in gal.
1910	97	650
1911	109	680
1912	108	602
1913	106	700
1914	103	702
1915	98	754

In the year ending Michaelmas, 1915, no fewer than 15 cows yielded upwards of 1,000 gal. per head, while 40 cows produced more than 800 gal. per head. No animal is retained in the herd if it gives less than 600 gal. 2 years in succession. Contrary to the general opinion, very little difficulty is experienced, as a rule, in fattening British Holstein cattle, and the butchers' price for these animals falls little short of that obtainable for the average milking shorthorn.

It is, perhaps, necessary to explain that the form of account was drawn up for the information of the owner and not with a view to publication. In addition to maintaining the British Holstein herd, the two farms in question (Baker's and Overhall) support a breeding flock of ewes and a number of bullocks and horses. The year 1914 was noteworthy for a shortage of roots, hence the limited amount of mangolds fed and the proportionately large amount of other foods, particularly hay, cake and beans. The method of feeding is that followed on most dairy farms: the mangolds are pulped and mixed with chaffed straw, hay and the concentrated feeding stuffs. In addition, a few pounds of hay are given unchaffed. Wet grains, to the extent of about 5 lb. per head per day, are at present being fed to the cows at Baker's farm only. Larger quantities are held to injure the health of the animals.

The herd lives under the healthiest of conditions. Throughout the winter the cows are turned out to grass for a few hours daily. The cow-sheds are commodious, well lighted and well ventilated. Mr. Bowlby believes strongly in plenty of light, both daylight and artificial light. At Overhall the buildings are lit by electricity, and at Baker's by gas. At the Overhall farm the housing accommodation was originally intended for bullocks. It consists of a large covered yard built in the form of a square and divided into a number of compartments by convenient feeding passages and by fencing. The cows are only tied up when being milked and fed. Ventilation is provided in the roof by means of louvre boards. On the side facing the south are a series of doorways large enough to admit

Dairy Herd Account (British Holstein

	£ s. d.	£ s. d.
To *Stock in hand at Michaelmas*, 1914—		
60 Cows (Overhall)	1,286 0 0	
38 ,, (Baker's)	793 0 0	
7 Bulls	188 0 0	
2 ,, yearlings	20 0 0	
50 Young Heifers, etc.	636 10 0	
3 Bull Calves	8 10 0	
2 ,, Calves } Unregistered	6 0 0	
5 Heifers } Unregistered	70 0 0	
7 Calves } Unregistered	20 0 0	
		3,028 0 0
Purchased during the year		Nil.
,, *Feed of Herd*—		
60 acres of Grass (Baker's) at 30*s*.	90 0 0	
20 ,, Aftermath (Baker's) at 15*s*. ..	15 0 0	
70 ,, of Grass (Overhall) at 30*s*. ..	105 0 0	
60 ,, Aftermath (Overhall) at 15*s*. ..	45 0 0	
		255 0 0
,, *Feeding Stuffs and Bedding*—		
Hay, 134 loads 7 trusses	396 4 2	
Straw, 380 loads 18 trusses	386 0 6	
Mangolds, 260½ tons	130 5 0	
Cake, 74½ tons	668 2 0	
Grains, 139½ qr. (Baker's)	19 18 3	
,, 20½ tons (Overhall)	17 12 8	
Dried Grains, 5 tons	35 0 0	
Beans, 144¾ qr.	229 0 0	
Bran, 9 tons 8 cwt.	69 15 0	
Oats, 16 qr. 2 bush.	16 11 0	
Wheat Meal, 8¾ qr.	15 11 0	
Barley Meal, 17½ qr.	26 5 0	
,, 9½ qr.	16 7 6	
Maize, 9½ qr.	10 19 0	
Middlings, 8 cwt.	3 4 0	
Treacle, 11½ cwt.	3 14 9	
Cattle Spice, 1 cwt.	1 10 0	
Calf Meal, 1 cwt.	15 0	
Three-fourths ..	2,046 14 10	1,535 1 1
,, *Railway Carriage of Milk and Grains* ..	164 3 7	
,, *Horse and Trap to Station, Repairs of Utensils, Veterinary Surgeon's Charges*	100 0 0	
,, *Wages*— Workers at 25*s*., 24*s*., 21*s*., 21*s*., 18*s*., 17*s*., 14*s*. (woman milker), 15*s*. (average), 5*s*. (part time only with stock); War bonus, say £1 per week for 3 months only = £8 5*s*. per week for 52 weeks	429 0 0	
		693 3 7
,, *Profit and Loss Account for Balance (profit)* ..		1,380 5 0
		£6,891 9 8

Total number of Cows, 98: gave 73,894 gal. of milk—a yearly average of 754 gal. per cow.

Cattle) for year ending Michaelmas, 1915.

	£	s.	d.	£	s.	d
By *Sale of Cows and Calves*	1,047	5	0			
,, ,, *of Bulls*	146	18	0			
				1,194	3	0
,, ,, *of Milk*	3,012	12	11			
,, *Value of Milk* supplied to Jersey Herd, 918 gal. at 7½*d.*	28	13	9			
				3,041	6	8
,, *Stock in hand at Michaelmas*, 1915—						
62 Cows (Overhall)	1,421	0	0			
36 ,, (Baker's)	781	0	0			
7 Bulls	179	0	0			
1 Bull Calf	4	0	0			
21 Young Heifers or Calves..	271	0	0			
				2,656	0	0
				£6,891	9	8

Averages of all Cows, 98 in number:
Value of milk per Cow £3,041 6*s.* 8*d.* ÷ 98 = £31 0*s.* 8*d.*
Balance, per Cow £1,380 5*s.* 0*d.* ÷ 98 = £14 1*s.* 8*d.*

a cart-load of straw. These are covered only about half-way up, with the result that the temperature in the yard is relatively low in winter time.

At Baker's farm, on the other hand, the buildings are much warmer. The cowshed contains a double row of stalls separated by a central feeding and dung passage. The health of the animals is better under the former set of conditions, but the yield of milk is believed to be slightly less, although this point is not yet definitely settled.

The heifers live, for the most part, out of doors, and drop their first calves when just under 3 years old. Yields of 4 gal. per day for some time after calving are commonly obtained from these heifers.

Milking is done twice daily, and no difficulty is experienced in keeping the milk up to the recognised standard of quality.

It may fairly be claimed that even under present conditions there has been a satisfactory return for capital invested. The success attained has not been due to circumstances beyond the control of other milk producers, but is attributed, mainly, to the keeping of milk records, and the use of home-bred stock.

SPECIAL interest attaches to the returns of the trade in agricultural produce during the year just ended, as this country was at war during the whole of this period.

Imports* of Agricultural Produce in 1915.

The total value of the principal articles of agricultural produce imported into the United Kingdom in 1915 was £276,803,000 as against £211,591,000 in 1914, £213,923,000 in 1913, and an average of £186,276,000 in the ten years 1903-1912. These figures represent the value (cost, insurance and freight), as declared to the Customs officers at the port of arrival, of the grain and flour, meat and animals for food, butter, cheese, eggs, condensed milk, fruit and vegetables, hops, lard, and margarine, which may be grouped together as agricultural products in the sense that they compete more or less directly with the home supply.

* These do not include certain goods which, at the time of importation, were the property of His Majesty's Government or the Governments of the Allies

There was thus the very large increase in the value of agricultural imports in the past year as compared with 1914 of some £65,212,000, *i.e.*, a percentage increase of 31 per cent.! With regard to the individual items in the trade it may be said that most of the articles (the chief exceptions being eggs, potatoes, and tomatoes) took part in this large increase; the outstanding features were increases of 41 per cent. in the value of the grain and flour imported, and of 38 per cent. in the value of the supplies of meat. The imports of dairy produce rose in value by £6,625,000 notwithstanding the fall in the imports of eggs above mentioned. The fluctuations in the trade of the various articles are fully considered below.

To compare adequately the 1915 figures with those for 1914 it is necessary to take the two periods January-July and August-December in each year, the latter period being a war period in 1914, while the former was a comparatively normal period.* These figures are shown in the following table:—

IMPORTS OF AGRICULTURAL PRODUCE.

Period.	1913.	1914.	1915.
	£	£	£
January to July ..	122,878,000	118,467,000	163,468,000
August to December ..	91,045,000	93,124,000	113,335,000
Whole year ..	*213,923,000*	*211,591,000*	*276,803,000*

This table shows that, comparing the war period August to December, 1915, with the war period August to December, 1914, there was a rise of 22 per cent. in the value of agricultural imports; while, comparing the war period January to July, 1915, with the peace period January to July, 1914, the rise in value was 38 per cent.

Though these figures give some idea of the large sum paid by the country for such food supplies as were needed to supplement home-produced foods, they are not a good index of the fluctuations in the volume of the trade owing to the recent important price movements. Generally speaking, the volume of this trade increased in the past year (butter, eggs and vegetables being notable exceptions), but the increase in value was mainly caused by higher prices.

* For various reasons (*e.g.*, cargoes being already afloat) the full effect, if any, of the outbreak of war would not be felt for some time after the beginning of August; but the last five months is the most convenient period to take.

Meat.—*Cattle and Beef.*—No live cattle for food were imported in 1915.

The imports of beef (chiefly chilled and frozen), after having steadily risen until in 1913 they reached the highest quantity yet recorded of 9,203,310 cwt., declined in 1914 to 8,844,567 cwt., and in 1915 to 8,610,511 cwt. The imports of fresh beef were extremely small, viz., 2,093 cwt. The main source of supply of chilled beef is Argentina, from which country the comparatively small total of 1,702,186 cwt. was received, as compared with 4,649,718 cwt. in 1914, and 5,216,022 cwt. in 1913. The extension of the chilled beef trade (usually representing the better class of meat), has been a noticeable feature of the dead-meat trade during recent years; but the total imports from all countries decreased in quantity from 5,248,004 cwt. in 1913 to 4,812,209 cwt. in 1914, and to 2,618,546 cwt. in 1915. The rise in price of this class of meat is illustrated by the fact that the average declared value was, per cwt., 37*s.* 3*d.* in 1913, 42*s.* 10*d.* in 1914, and 61*s.* 7*d.* in 1915. The trade in chilled beef between the United States and this country revived in 1915, when 608,908 cwt. were sent. Uruguay began to contribute to our supplies of chilled beef in 1913, the imports from that country in that year being 31,982 cwt.; these increased in 1914 to 160,412 cwt., and in 1915 to 289,113 cwt.

The frozen beef imports increased again both in quantity and value in 1915; we received 5,989,872 cwt. of frozen beef in 1915, valued at £17,798,422, compared with 4,027,106 cwt. in 1914, valued at £8,734,610, *i.e.*, the imports more than doubled in value on the year. The countries chiefly engaged in this trade are Argentina, Uruguay, Australia and New Zealand, and the United States. In 1915 the supplies were as follows (1914 figures in brackets):—United States, 392,443 cwt. (85,510 cwt.), valued at £1,170,454 (£241,084); Argentina, 3,394,275 cwt. (1,343,408 cwt.), valued at £10,164,557 (£3,177,598); Australia, 1,245,762 cwt. (1,551,001 cwt.), valued at £3,596,434 (£3,247,323); and New Zealand, 735,226 cwt. (476,680 cwt.), valued at £2,176,621 (£944,459). The United States had dropped out of this trade for several years previous to 1913. Uruguay is taking a rapidly-increasing share in this trade also (the imports rose steadily from 65,485 cwt. in 1911 to 569,367 cwt. in 1914, but in 1915 there was a drop to 74,500 cwt., valued at £232,258). The frozen beef from all sources averaged 59*s.* 5*d.* per cwt., compared with 43*s.* 4½*d.* in 1914.

The imports of chilled and frozen beef for the two periods of both 1914 and 1915 are shown in the following table:—

Period.	Quantity.		Value.	
	1914.	1915.	1914.	1915.
	Cwt.	Cwt.	£	£
	CHILLED BEEF.			
January—July ..	3,734,600	1,651,366	7,403,703	4,902,969
August—December ..	1,077,609	967,180	2,907,144	3,163,314
Total	4,812,209	2,618,546	10,310,847	8,066,283
	FROZEN BEEF.			
January—July ..	2,104,546	3,113,758	3,757,091	8,916,830
August—December ..	1,922,560	2,876,114	4,977,519	8,881,592
Total	4,027,106	5,989,872	8,734,610	17,798,422

Sheep and Mutton.—There were no imports of live sheep for food in 1915. The quantity of mutton imported decreased from 5,199,731 cwt. in 1914 to 4,730,705 cwt. in 1915. Nearly all of it came in the form of frozen mutton, chiefly from New Zealand (2,422,806 cwt.), Australia (1,277,339 cwt.), Argentina 781,735 cwt.), and Uruguay (39,107 cwt.). The quantities received from Uruguay and New Zealand were greater than in the preceding year, while the receipts from Australia and Argentina were less. The quantity of fresh mutton received was only 48,941 cwt., practically all of this coming from Holland. There were no imports of chilled mutton in 1915.

The declared value of the fresh mutton was 52*s.* 8*d.* per cwt., *i.e.*, the same as in 1914; that of frozen mutton was 59*s.* in 1915 compared with 43*s.* 7½*d.* in 1914.

Rabbits.—The receipts of fresh rabbits, owing to the Belgian supplies being cut off, amounted to only 8,727 cwt., and the bulk of the rabbit supply was composed of frozen rabbits from Australia and New Zealand, the former country sending 506,790 cwt., and the latter 88,138 cwt. The value per cwt. of the frozen rabbits was 29*s.* 10¾*d.*

Pork.—A total of 269,305 cwt. of fresh and frozen pork was received in 1915 compared with 861,203 cwt. in 1914. Almost half in 1915 was frozen pork, coming mainly from the United States; the fresh pork comes from Holland. The imports of salted pork (not bacon or hams) were 106,974 cwt.

Bacon and Hams. The imports of bacon in 1915 (6,523,377 cwt.) showed an increase compared with 1914, and the total is the largest recorded. Denmark sent 2,063,221 cwt., as compared with 2,714,807 cwt. in 1914, and 2,334,945 cwt. in 1913; and in these three years the United States sent 3,529,599 cwt. 1,522,958 cwt., and 1,803,371 cwt.; and Canada, 864,185 cwt., 342,286 cwt., and 243,522 cwt.

The declared average value was 78*s.* per cwt., as compared with 71*s.* 6*d.* in 1914, and 71*s.* 9*d.* in 1913.

Hams were imported to the extent of 1,485,191 cwt. in 1915, compared with 838,830 cwt. in 1914. Nearly all come from the United States.

Poultry and Game.—The number of live poultry imported dropped from 541,161 in 1914 valued at £23,698, to 19,434 in 1915 valued at £1,079. Dead poultry is chiefly received from Russia, the United States and France; there was a decrease in

IMPORTS OF LIVE AND DEAD MEAT.

Description.	Quantity.		Value.	
	1914.	1915.	1914.	1915.
	Number.	Number.	£	£
Cattle	2,234	—	46,295	—
Sheep and Lambs ..	1,707	—	3,000	—
Total live animals ..	—	—	49,295	—
	Cwt.	Cwt.		
Beef, fresh and refrigerated	8,844,567	8,610,511	19,060,371	25,870,520
Beef, salted	29,841	68,258	65,262	181,176
Mutton, fresh and refrigerated	5,199,731	4,730,705	11,410,310	13,936,148
Pork, fresh and refrigerated	861,203	269,305	2,360,722	795,409
Pork, salted	261,141	106,974	302,477	215,161
Bacon	5,098,080	6,523,377	18,225,568	25,441,460
Hams	838,830	1,485,191	3,063,078	5,296,689
Meat, unenumerated—				
Fresh and refrigerated	813,757	774,234	1,693,984	1,796,161
Salted	139,534	102,833	180,329	163,946
Meat, preserved ..	995,211	2,037,651	5,112,291	11,652,462
Rabbits, dead	505,925	603,659	747,643	914,367
Total dead meat ..	23,587,820	25,312,698	62,222,035	86,263,499
Poultry—	Number.	Number.		
Alive	541,161	19,434	23,698	1,079
	Cwt.	Cwt.		
Dead	223,599	156,438	775,263	654,314
Game—				
Alive	—	—	23,809	8,588
Dead	—	—	120,956	23,865

both quantity and value compared with the preceding year, Russia, *e.g.*, sending only 8,591 cwt. against 114,921 cwt. in 1914. The value of the imported live game was £8,588, and of dead game £23,865.

Total Imports of Meat.—It appears that the quantity of meat of all kinds (excluding poultry and game) available, in addition to the home supply, was about 25,312,700 cwt., as compared with 23,588,000 cwt. in 1914, and 23,278,000 cwt. in 1913. This was not entirely consumed in this country, as there was a small re-export.

The total value credited to the different kinds of live and dead meat, including poultry and game, was £86,951,000, as compared with £63,215,000 in 1914, and £56,726,000 in 1913.

The imports of dead meat in the two periods January-July and August-December are shown in the following table:—

Period.	Quantity.		Value.	
	1914.	1915.	1914.	1915.
	Cwt.	Cwt.	£	£
January—July ..	14,968,382	15,283,666	36,377,568	50,905,727
August—December ..	8,619,438	10,029,032	25,844,467	35,357,772
Whole year ..	23,587,820	25,312,698	62,222,035	86,263,499

The home production of meat forms about 60 per cent of the total supply.

Dairy Produce.—*Butter.*—Three-quarters of the butter supplied to this country from abroad came from the Continent of Europe, Denmark (1,327,100 cwt.), Russia (1,017,507 cwt.), France (352,090 cwt.), Sweden (129,505 cwt.), and Holland (44,622 cwt.) being the chief contributors. Almost the whole of the remainder was received from Australia (371,670 cwt.), New Zealand (374,898 cwt.), and Argentina (82,947 cwt.).

The quantity of butter received was below the imports of 1914 and 1913; a significant fact is that Russia and France sent largely increased quantities, while the imports from Sweden, Denmark and Holland show large decreases. The value was 140*s.* 3*d.* per cwt., as compared with 120*s.* 7*d.* in 1914 and 116*s.* 5*d.* in 1913.

In 1907-8 (the only year for which figures are available) the home production of butter was equivalent to 35 per cent. of the total requirements.

Cheese.—The supply of cheese was larger than in 1914, 1913 or 1912. Half our imported cheese comes from Canada; the imports from this source in 1915 (1,315,177 cwt.) almost regained the level at which they stood in 1912. New Zealand sent 709,326 cwt.

Eggs.—The supply of eggs steadily increased in recent years, viz., from 17,710,431 great hundreds in 1909 to 21,579,950 in 1913; in 1914, however, the imports dropped to 17,905,285 great hundreds, and there was a further very large fall in 1915 to 10,247,960 great hundreds. Russia and Denmark are the chief contributors to the trade, but, compared with 1914, the supplies from Denmark in 1915 decreased from 4,315,900 to 2,657,835 great hundreds, and those from Russia from 6,870,827 to 3,074,156 great hundreds. Holland sent 874,013 great hundreds to this country in 1915 compared with 1,192,286 in 1914.

The Trade Returns now distinguish the "egg yolk and liquid, and albumen" imported, the total value of which was £845,564 in 1915.

IMPORTS OF DAIRY PRODUCE, MARGARINE, AND EGGS.

Description.	Quantity.		Value.	
	1914.	1915.	1914.	1915.
	Cwt.	Cwt	£	£
Butter	3,984,204	3,855,395	24,014,276	27,035,703
Margarine	1,529,219	2,052,183	3,977,361	5,751,253
Cheese	2,433,864	2,726,942	7,966,162	11,113,869
Milk, condensed ..	1,225,316	1,581,799	2,154,169	3,366,069
	Great hundreds.	Great hundreds.		
Eggs	17,904,805	10,247,960	8,652,800	6,122,970

Grain and Meal.— There was a big decline in the imports of wheat in 1915. The leading sources of supply were India (13,959,900 cwt.), Canada (19,724,800 cwt.), Argentina (12,162,900 cwt.), United States (41,649,000 cwt.), the noteworthy features of the wheat trade in 1915 being the disappearance to a large extent of Russian and Australian wheat from the trade, the large drop in the imports from Canada, and increased supplies from the other large sources.

The receipts of flour showed some increase on 1914, chiefly owing to increased imports from the United States and Canada, the two principal countries in this trade.

The total (*i.e.*, home and overseas) normal wheat requirements of the United Kingdom (*i.e.* grain, wheatmeal and flour), are

about 150 million cwt., the home production forming about 22 per cent. of the whole; this is shown in the following table:—

Annual Average.	Normal Requirements.	Supplies.		Proportion of Supply.	
		Home.	Over-seas.	Home.	Over-seas.
	Million cwt.	Million cwt.	Million cwt.	Per cent.	Per cent.
1901–05	138.8	28·7	110·1	20·7	79·3
1906–10	143.2	31·9	111·3	22·3	77·7
1911–13	149.2	32·9	116·3	22·1	77·9

The proportionate contribution from the Dominions and India to the total wheat requirements of the United Kingdom shows a very marked increase, having risen from 23·7 per cent. in the period 1901-5 to 39·5 per cent. in 1911-13. This large increase is to be mainly accounted for by the great extension of wheat cultivation in Canada since 1900.

An important point is that, while in foreign countries, both European and extra-European, the increase in the wheat area is proceeding at practically the same rate as the increase of population, in the British Empire the wheat area is developing far more rapidly, so that the Empire as a whole is becoming more self-supporting; this point is brought out in the following table based on estimates made by the Board in 1912:—

Wheat-growing Countries.	Wheat Area.		Percentage Increase.	Population.		Percentage Increase.
	1901.	1911.		1901.	1911.	
	Thousand acres.	Thousand acres.		Thousands.	Thousands.	
British Empire (United Kingdom, Canada, Australia, New Zealand, and India).	34,636	50,490	+ 45·5	283,385	302,154	+ 6·6
European Countries ..	98,326	115,105	+ 17·1	291,685	337,181	+ 15·6
Others	67,908	81,408	+ 19·9	139,927	168,818	+ 20·6

The imports of barley, after rising in 1913, dropped again in 1914 and 1915. The principal contributors were the United States (5,814,485 cwt.), and India (2,765,800 cwt.). For all practical purposes Russia and Rumania dropped out of the trade.

The imports of barley normally form about 40 per cent. of the total estimated consumption.

Oats amounting to 15,640,100 cwt. were imported in 1915, this figure being an increase of 1,500,000 cwt. over that of 1914.

None came from Russia, Germany or South-Eastern Europe, and Canada sent only 386,200 cwt. compared with 1,758,000 cwt.

in 1914; the increase was mainly due to the United States sending 8,183,200 cwt. in 1915 as against 3,009,615 cwt. in 1914.

The imports of oats form normally about 25 per cent. of the total estimated consumption.

IMPORTS OF GRAIN AND FLOUR.

Description.	Quantity.		Value.	
	1914.	1915.	1914.	1915.
	Cwt.	Cwt.	£	£
Wheat	103,926,743	88,681,800	44,734,079	57,313,171
Wheat meal and flour	10,060,223	10,489,170	5,549,048	8,314,733
Barley	16,044,422	12,290,485	5,660,312	6,027,857
Oats	14,156,715	15,640,100	4,674,417	8,488,539
Oatmeal	609,992	890,481	502,938	878,686
Maize	39,040,747	48,566,400	11,760,912	18,897,373
Maize meal	232,469	247,396	78,895	112,571
Peas	983,694	1,100,453	546,470	872,907
Beans	1,441,559	1,142,810	502,928	534,139
Other corn and meal..	13,828,443	22,244,455	5,626,270	10,922,715
Total	200,325,007	201,293,550	79,636,269	112,362,691

The supply of maize (48,566,400 cwt.) nearly regained the figure of 1913. Compared with 1914 there were increases in the imports from the United States, Canada, and Argentina; Rumania and Russia dropped out.

It may be of interest to compare the total imports of grain and flour in the two periods January-July and August-December:—

Period.	Quantity.		Value.	
	1914.	1915.	1914.	1915.
	Cwt.	Cwt.	£	£
January—July ..	105,092,363	115,083,845	39,742,957	66,424,355
August—December ..	95,232,644	86,209,705	39,893,312	45,938,336
Whole year ..	200,325,007	201,293,550	79,636,269	112,362,691

Fruit and Vegetables. — The quantity of potatoes received was less than one quarter of that in 1914. The imports from all countries decreased. The chief countries in this trade were Holland, France, and the Channel Islands; Germany, of course, ceased to export. The other vegetables imported are mainly onions and tomatoes; 7,472,440 bushels of onions, valued at

£1,789,080, and 1,394,897 cwt. of tomatoes, valued at £1,525,343, were imported. With regard to fresh fruit, there were increases in the imports of apples, almonds and oranges, but decreases in all other kinds.

Hops were imported to the extent of 200,337 cwt., as against 97,306 cwt. in 1914, and at a lower price.

Wool. — As regards wool, the quantity imported was well above that of 1914 or 1913, and the average price was rather higher viz., 11*d.* per lb. compared with 10½*d.* in 1914 and 10¼*d.* in 1913. The bulk of the supply came from our Colonies and Possessions, viz., Australia (426,163,648 lb.), New Zealand (200,031,839 lb.), British South Africa (136,565,278 lb.), and India (65,435,605 lb.). Argentina sent 60,968,009 lb. The total receipts were 926,680,036 lb., as compared with 712,618,116 lb. in 1914, and 800,580,815 lb. in 1913.

The re-exports of Foreign and Colonial wool were 122,722,232 lb. as against 295,078,648 lb. in 1914, and 306,480,308 lb. in 1913, so that the balance of wool (other than home produce) remaining for manufacture in this country was 803,958,000 lb. as compared with 417,539,000 lb. in 1914 and 494,101,000 lb. in 1913.

Oil Seeds. — In view of the importance of an adequate supply of oil cakes for feeding purposes, the amount and value of the oil seeds of various descriptions imported during 1915 is worthy of special consideration. The following table gives the details of the trade so far as they are available (including oil-seed cake):—

Description.	Quantity.		Value.	
	1914.	1915.	1914.	1915.
			£	£
Cotton seed .. tons	639,572	494,565	4,420,307	4,122,193
Flax seed or Linseed, qr.	2,451,778	2,126,409	5,723,846	5,573,622
Rape seed .. "	309,241	192,336	622,927	464,220
Soya Beans .. tons	71,161	175,136	593,190	1,461,525
Nuts and Kernels (for expressing Oil) tons	168,847	448,360	3,595,417	8,001,791
Oil-seed cake .. cwt.	329,431	425,113	1,988,839	3,273,139

There was thus a considerable decrease in the quantities of cotton seed, linseed and rape seed imported in 1915 compared with the previous year, but the imports of soya beans, after diminishing steadily since 1910, when 421,521 tons were imported, rose from 71,161 tons in 1914 to 175,136 tons in 1915, and a substantial increase also occurred in the weight of nuts and

kernels imported for the purpose of extracting oil, the figures for the past three years being 448,360 tons in 1915, against 168,847 tons in 1914 and 81,120 tons in 1913.

Prices. — Some indication of the range of prices may be gathered from the average declared value of the different articles, but only to an approximate extent, as an increased importation of a cheaper quality of any article depresses the average value and *vice versa*, although no real change in price may have taken place. With this reservation it may be said that the record for the past year shows, on the whole, a very decided increase in the prices of meat of all kinds (except hams), dairy produce and cereals. The increases per cwt. were as follows:—Beef, 17*s.* (40 per cent. or 100 per cent. compared with the 1911 prices); mutton, 15*s.* (or 34 per cent.); pork, 4*s.* 3*d.*; bacon, 6*s.* 6*d.*; butter, 19*s.* 8*d.* (or 16 per cent.); cheese, 16*s.* (or 24 per cent.); eggs, 2*s.* 3*d.* (per great hundred) (or 23 per cent.); wheat, 4*s.* 4*d.* (or 50 per cent.); wheat flour, 4*s.* 10*d.* (or 44 per cent.); barley, 2*s.* 9½*d.* (or 40 per cent.); oats, 4*s.* 3*d.* (or 65 per cent.); and maize, 1*s.* 9*d.* (or 29 per cent.). There was a decrease in the price of hams of 1*s.* 7*d.* per cwt. The figures for some of the principal articles are as follows:—

AVERAGE DECLARED VALUES OF AGRICULTURAL PRODUCE IMPORTED.

Description.		1912.	1913.	1914.	1915.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.
Cattle	Head	20 1 11	20 12 10	20 14 6	—
Sheep and lambs	,,	1 10 10	1 10 0	1 15 2	—
Beef, fresh and refrigerated	cwt.	1 14 2	1 14 11	2 3 1	3 0 1
Mutton, fresh and refrigerated	,,	1 18 7	2 0 11	2 3 11	2 18 11
Pork, fresh and refrigerated	,,	2 13 1	2 15 3	2 14 10	2 19 1
Bacon	,,	3 2 10	3 11 9	3 11 6	3 18 0
Hams	,,	3 0 7	3 11 9	3 13 0	3 11 4
Butter	,,	6 1 7	5 16 5	6 0 7	7 0 3
Cheese	,,	3 4 3	3 1 3	3 5 6	4 1 6
Eggs	Great hundred	0 8 10	0 8 11	0 9 8	0 11 11
Wool	lb.	0 0 10	0 0 10¼	0 0 10½	0 0 11
Wheat	cwt.	0 8 6	0 8 3	0 8 7	0 12 11
,, flour ..	,,	0 10 10	0 10 7	0 11 0	0 15 10
Barley	,,	0 7 10	0 7 2	0 7 0½	0 9 10
Oats	,,	0 6 11	0 6 3	0 6 7	0 10 10
Maize	,,	0 6 2	0 5 7	0 6 0	0 7 9

Miscellaneous. — In addition to the agricultural products already mentioned there are some articles of importance which may be referred to as of interest to the agricultural industry. The figures for these are given in the following table:—

MISCELLANEOUS IMPORTS.

Description.	Quantity.		Value.	
	1914.	1915.	1914.	1915.
	Cwt.	Cwt.	£	£
Wood and Timber ..	—	—	25,343,111	32,778,764
Tallow and Stearine ..	1,737,182	1,773,105	2,861,676	3,121,500
Hides:				
Dry	639,208	734,395	2,976,458	3,508,960
Wet	753,287	1,077,089	2,935,281	4,976,571
Manures:	Tons.	Tons.		
Basic Slag	16,572	—	31,819	—
Bones, burnt and unburnt	34,404	27,761	186,001	179,815
Guano	39,285	26,720	232,086	182,015
Nitrate of Soda ..	171,910	132,158	1,721,138	1,505,085
Phosphate of Lime and Rock Phosphate	562,242	374,639	970,337	704,749
	Cwt.	Cwt.		
Seeds, Clover and Grass	175,905	260,375	410,737	707,293
Flowers, fresh	—	—	222,842	185,746
	No.	No.		
Horses	8,662	8,692	315,887	396,055

In conclusion, it may be of interest to indicate that the proportionate production in the United Kingdom of the chief articles of food has in recent years remained substantially constant:—

—	1901–5.		1906–10.		1911–13.	
	Home Supply.	Overseas Supply.	Home Supply.	Overseas Supply.	Home Supply.	Overseas Supply.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Meat ..	59·3	40·7	58·8	41·2	59·2	40·8
Wheat ..	20·7	79·3	22·3	77·7	22·1	77·9
Barley ..	57·5	42·5	62·1	37·9	57·4	42·6
Oats ..	77·5	22·5	80·3	19·7	75·1	24·9
Potatoes	93·8	6·2	96·9	3·1	98·1	1·9

Purchase of Clover Seed.

THE Board of Agriculture and Fisheries desire to direct the attention of farmers to the shortage which exists in the supplies of White Clover seed. This shortage is due, partly to a falling off in last year's home-production, but chiefly to the stoppage of exports from enemy countries. To meet this difficulty, mixtures of White Clover with the much cheaper Alsike and Suckling Clovers are now on offer, but the purchase of such mixtures of clovers is very undesirable owing to their different values and uses. Alsike

cannot take the place of White Clover in long "leys," nor can White Clover replace Alsike for mowing. As to Suckling Clover, its produce is so insignificant as scarcely to entitle it to a place at all in British husbandry.

It is no easy matter for farmers to determine the proportions in which seeds are mixed, and so ascertain whether they are receiving fair value. For these reasons the Board would advise farmers not to purchase such mixtures, but to buy the different kinds of seeds separately and mix them themselves. Seed merchants should be asked for suitable guarantees of purity and germination of all seeds purchased. (See the Board's Special Leaflet No. 24, *Seed Testing*).

Farmers accustomed to sow for sheep grazing mixtures composed mainly or entirely of clovers, should consider the advisability of replacing a proportion of White Clover by rye-grasses. For one year's grazing, under average circumstances, the following mixture will be found useful :—

5 lb. Perennial rye-grass.	2 lb. Alsike clover.	Total, 18 lb. per acre.
5 ,, Italian rye-grass.	2 ,, White clover.	
2 ,, Red clover.	1 ,, Trefoil.	
1 ,, Single cut cowgrass.		

For mowing, White Clover may be reduced to 1 lb., or be omitted altogether. For a 2 to 3-year ley, to be mown the first year if necessary, the following mixtures would be suitable in districts with an average rainfall (*A*) exceeding 30 in. per annum, and (*B*) under 30 in. per annum :—

	A.—lb. per acre.	*B*.—lb. per acre.
Perennial rye-grass	10	5
Italian rye-grass	3	3
Cocksfoot	6	8
Timothy	2	2
Tall oat-grass	—	2
Broad red clover	2	2
Single cut cowgrass	1½	1½
Alsike	1	1
White clover	1	1
Trefoil	—	½

It should be remembered that White Clover is most successful when the land is well stocked with phosphates.

As to mixtures suitable for permanent grass, see the Board's Leaflet No. 168 (*The Formation of Permanent Pastures*).

Palm-nut Kernel Cake.

RECOMMENDATIONS with regard to the use of palm-nut kernel cake, based, to some extent, on German experience, were made in the *Journal* for February, 1915, p. 1,025. Since this article was published the results of various experiments in England and Scotland have become available ; these

DAIRY COWS.

Experimental Centre.	Number of Animals and Period of Experiment.	Basal Ration.	Foods compared, and *Quantities.*	Milk Yield.	Remarks.
Lancs C.C. Farm School, Hutton.	12, two lots of 6. 2 months.	Hay, roots, mixed meal.	Dec. cott. cake, 5 lb. (a) Palm-nut kernel cake 7½ lb. (a).	More milk from dec. cott. cake.	Dec. cott. cake eaten with greater relish. No marked differences in composition of milk. Palm-nut kernel cake had no undesirable effects on butter. Better results might have been obtained if smaller allowances of palm-nut kernel cake had been fed mixed with other cakes.
Durham C.C., Offerton Hall.	10, two lots of 5. 2 months.	Swedes, meadow hay, oat straw, malt culms, soya bean cake, oat straw chaff.	Bombay cott. cake, 6 lb. Palm-nut kernel cake, 6 lb.	Palm-nut kernel cake quite as good and possibly better for milk production.	Palm-nut kernel cake increased the percentage of fat in the milk; but there was no evidence that the total weight of butter fat produced per day in the milk had been increased. Palm-nut kernel cake has a steadying influence on the maintenance of the normal quality of the milk. General health of animals good; palm-nut kernel cake animals had looser skins, glossier look and better "bloom."
Leeds University and Yorks Council for Agricultural Education, Garforth.	8, two lots of 4.	....	Egyptian cott. cake, 4 lb. Palm-nut kernel cake, 4 lb.	*Palm-nut kernel* cake gave 1⅝ lb. *more* milk per cow per day.	Palm-nut kernel cake produced a slight increase in the yield of fat.
Hants C.C. Farm School, Sparsholt.	18	....	Palm-nut kernel cake replaced soya bean cake and dec. cott. cake.	Milk and butter quite normal.	Found to be safe and *suitable food for dairy cows.* Should be given at the commencement of the winter feeding before the cows have become accustomed to other concentrated foods.
University College of N. Wales.	..	Cows on grass ..	Egyptian cott. cake. Palm-nut kernel cake.	Results from equivalent quantities identical.	Difficulty at first with feeding; but became accustomed to it and took it if mixed with small quantity of other food.
E. Sussex C.C., Uckfield.	..	....	Bombay cott. cake. Palm-nut kernel cake.	Equal milk yields.	....
Harper Adams Agricultural College.	4, two lots of 2. 6 weeks.	Dairy meal and linseed cake.	Dec. cott. seed meal, 2 lb. Palm-nut ernel cake, 3 lb.	Dec. cott. seed meal, 3,471 lb. Palm-nut kernel cake, 3,412 lb.	Cake taken readily after first day or two. No effect on colour, taste, or smell of milk. *Butter of quite satisfactory* texture, slight tendency to paleness, but of good flavour.

(a) At the time, these quantities represented equal *money value:* Decorticated cotton cake £8 12s. 0d. per ton; Palm-nut kernel cake £5 2s. 6d. per ton.

CATTLE FEEDING.

Experimental Centre.	Number of Animals and Period of Experiment.	Basal Ration.	Foods compared, and Quantities.	Live Wgt. Incr. per head per day.	Cost per cwt. Live Wgt. Incr.	Remarks.
					s. d.	
Norfolk Agricultural Station.	20, two lots of 10, 8 weeks.	Swedes, hay and straw chaff, cotton cake.	Linseed cake 3–3½ lb. Palm-nut kernel cake 3–3½ lb.	Identical	..	Cattle ate the palm-nut kernel cake readily, and these animals realised a slightly better price per cwt. from the butcher than those fed on linseed cake.
E. Sussex C.C., Uckfield.	....	....	Bombay cott. cake. Palm-nut kernel cake.	Palm-nut kernel cake better.	..	....
Edinburgh and East of Scotland College of Agriculture.	32, four lots of 8. 4 winter months.	Swedes, bran, oat straw.	Bombay cott. cake 4½ lb. Dried dist. grains 4½ lb. Bombay cott. cake 2 lb. Chaffed hay 5½ lb. .. Palm-nut kernel cake 4½ lb.	1·76 lb. 2·02 „ 1·61 „ 2·04 „	43 9 (b) 39 0 (b) 51 11 (b) 39 5 (b)	Palm-nut kernel cake was practically equal *in value to* the best classes of dried distillers' grains, which it somewhat resembles in composition. Cattle do not eat it when first put before them, but take to it readily *after a few days*; and there appears to be no practical difficulty in feeding it to fatting bullocks when accustomed to it from beginning of *fattening* period. *Quality of beef satisfactory.*
Aberdeen and North of Scotland College of Agriculture.	30, three lots of 10. 84 days.	Turnips and straw. Cakes mixed with locust bean meal.	Linseed cake 3–5 lb. Dec. cott. cake 3–5 lb. Palm-nut kernel cake 3–5 lb.	Practically identical.	51 6 (c) 45 6 (c) 43 4 (c)	Palm-nut kernel cake gave the best monetary return. Eaten readily by stock when mixed with locust bean meal. No difficulty in storing cake.
Glasgow and West of Scotland College of Agriculture.	....	....	Bran. Palm-nut kernel cake.	Bran slightly inferior.	..	....
Highland and Agricultural Society.	....	....	Hay. Hay and palm-nut kernel cake 2 lb.	..	..	Young cattle wintered very much better on palm-nut kernel cake and hay than on hay only. Cattle ate the cake greedily.

(b) The net costs of the foods (*i.e.*, deducting manurial values from cost price) were: Bombay cotton cake £4; Dried distillers' grains £5; Chaffed hay £3 4s. 0d.; Palm-nut kernel cake £5 4s. 6d. per ton.

(c) The net costs of the foods were: Linseed cake £7 17s. 6d.; Decorticated cotton cake £6 11s. 0d.; Palm-nut kernel cake £5 6s. 0d. per ton.

are summarised, so far as they relate to dairy cows and fattening cattle, in the accompanying tabular statements.

Enquiries instituted by the Board have shown that the cake is already being used to a considerable extent by farmers in this country, and that it is proving a wholesome and useful feeding stuff.

The foundations for the establishment of the palm kernel oil and cake industry in this country have now been laid ; with a prospect of a market for the cake, oil seed crushers are purchasing the kernels, and it is clear that, as one result of the war, the farmer has had an important feeding stuff placed at his disposal.

Agriculturists are advised to use this feeding stuff and to support the effort now being made to establish the palm-kernel crushing industry firmly in this country, for there is no doubt that Germany will make great efforts to regain it after the war.

The prices per ton at London, Liverpool, Hull and Bristol, and the prices per food unit are given every month in this *Journal* (see pages 1002 and 1003), and are compared with the prices of better-known feeding stuffs ; information is also given monthly with regard to the inclusion of this feeding stuff in the rations of the various classes of animals.

Notes on Feeding Stuffs in January: *From the Animal Nutrition Institute, Cambridge University.*

THIS month's notes call for no new feature. The prices per ton and per food unit for the usual standard feeding stuffs at the four great port markets at the end of December are given in Table I. Cotton seed is included for the first time, a correspondent having asked why cotton seed was a cheaper food than cotton cake. A similar question as to the relative price of linseed and linseed cake was raised some months ago. When quotations for linseed were obtained it was found that linseed was not cheaper per unit than linseed cake. It appears, however, that Egyptian cotton seed is rather cheaper than cotton cake. Analyses of Brazilian cotton seed are not available, and it has, therefore, not been possible to work out its price per food unit for comparison with Egyptian cotton seed and cotton cake. The writer has no experience of the use of cotton seed for food.

Readers are once more reminded that in calculating the

TABLE I.

Feeding Stuff.	Reckoned from digestible nutrients.		Approximate prices per ton at the end of December.				Approximate prices per Food Unit.			
	Nutritive Ratio.	Food Units.	London.	Liverpool.	Hull.	Bristol.	London.	Liverpool.	Hull.	Bristol.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
Soya bean cake	1 : 1·1	122·3	10 10 0	10 15 0	10 5 0	10 10 0	1 8½	1 9	1 8	1 8½
Decorticated cotton cake	1 : 1·2	126·3	11 10 0	12 0 0	—	11 10 0	1 9¾	1 10¾	—	1 9¾
Indian linseed cake	1 : 1·9	123·1	12 1 3	12 10 0	—	—	1 11½	2 0¼	—	—
English linseed cake	1 : 2·0	120·1	12 10 0	13 0 0	12 0 0	12 12 6	2 1	2 2	2 0	2 1¼
Bombay cotton cake	1 : 2·5	65·3	9 5 0	9 5 0	9 5 0	9 7 6	2 10	2 10	2 10	2 10¼
Egyptian cotton cake	1 : 2·1	71·9	9 7 6	9 12 6	9 15 0	9 17 6	2 7¼	2 8¼	2 8½	2 9
Coconut cake	1 : 3·8	102·6	9 10 0	9 5 0	—	—	1 10¼	1 9½	—	—
Palm-nut kernel cake	1 : 4·0	83·5	8 0 0	8 5 0	—	8 15 0	1 11	1 11¾	—	2 1¼
Ground-nut cake	1 : 0·8	145·2	*10 5 0	9 15 0	10 15 0	9 15 0	1 5	1 4	1 5¾	1 4
English beans	1 : 2·6	99·5	10 18 11	12 12 0	10 18 11	11 7 4	2 2½	2 6¼	2 2½	2 3½
Chinese beans	1 : 2·6	101·2	11 4 0	—	—	—	2 2½	—	—	—
English maple peas	1 : 3·1	97·2	14 13 4	—	13 6 8	—	3 0¼	—	2 8¾	—
English dun peas	1 : 3·1	97·2	13 6 8	—	11 11 1	—	2 8¾	—	2 4½	—
Calcutta white peas	1 : 2·1	97·5	16 0 0	—	15 11 1	—	3 3½	—	3 2¼	—
American maize	1 : 11·5	93·8	10 5 4	10 8 2	—	—	2 2¼	2 2¾	—	—
Argentine maize	1 : 11·3	94·2	10 0 8	10 7 2	10 3 0	10 0 8	2 1½	2 2½	2 1¾	2 1½
Maize meal	1 . 13	86·5	11 0 0	11 2 6	10 17 6	10 7 6	2 6½	2 6¾	2 6	2 4¾
Maize gluten feed	1 : 3·0	121·6	10 2 6	—	—	10 7 6	1 8	—	—	1 6¾
Maize germ meal	1 : 8·5	99·2	10 15 0	11 0 0	—	10 10 0	2 2	2 2½	—	2 1½
English feeding barley	1 : 8·0	83·0	13 8 10	—	14 0 0	11 18 0	3 2¾	—	3 4½	2 10½
English oats	1 : 8·0	75·4	11 13 4	11 8 2	11 0 0	11 5 0	3 1¼	3 0¼	2 11	2 11¾
Argentine oats	1 : 8·0	75·4	11 10 3	10 17 9	—	11 1 1	3 0¾	2 10½	—	2 11¼
Malt culms	1 . 3·6	69·9	6 15 0	8 5 0	7 0 0	7 10 0	1 11¼	2 4¼	2 0	2 1¾
Brewers' grains (dried)	1 : 3·5	84·5	8 5 0	—	8 0 0	8 10 0	1 11½	—	1 10¾	2 0¼
Brewers' grains (wet)	1 : 3·5	21·1	1 10 0	—	1 5 0	—	1 5	—	1 2¼	—
Egyptian rice meal	1 : 9·4	78·7	10 5 0	—	—	9 0 0	2 7¼	—	—	2 3½
Burmese rice meal	1 : 9·4	78·7	9 15 0	8 15 0	8 10 0	—	2 5¾	2 2¾	2 2	—
Wheat middlings	1 : 5·3	93·4	10 0 0	—	10 0 0	11 5 0	2 1¾	—	2 1¾	2 5
Wheat sharps	1 : 5·0	86·3	10 5 0	10 2 6	10 5 0	10 5 0	2 4½	2 4¼	2 4½	2 4½
Wheat pollards	1 : 5·3	81·9	—	8 15 0	—	—	—	2 1¾	—	—
Wheat bran	1 : 4·7	77·5	8 10 0	8 15 0	8 15 0	8 10 0	2 2¼	2 3	2 3	2 2¼
Wheat bran (broad)	1 : 4·7	79·9	9 0 0	9 7 6	9 15 0	9 0 0	2 3	2 4¼	2 5¼	2 3
Feeding treacle	—	60·0	—	9 2 6	—	—	—	3 0½	—	—
Linseed	1 : 5·9	153·5	18 0 9	18 0 0	19 14 2	18 8 10	2 4¼	2 4¼	2 6¾	2 4¾
Linseed oil	—	250·0	38 0 0	40 0 0	36 10 0	43 11 0	3 0½	3 2½	2 11	3 5¾
Cotton seed, Egyptian	1 : 5·5	115·5	14 0 0	—	14 2 6	—	2 5	—	2 5¼	—
" " Brazilian	—	—	9 5 0	9 10 0	—	—	—	—	—	—

* 2nd grade £9 15s.

number of food units per ton account is only taken of the percentages of *digestible* nutrients, and that the figures are based on the average of the most reliable results recorded. Some of the more enterprising manufacturers are now quoting prices per food unit, but it appears to be their custom to calculate from the *total* nutrients and not, as here, from the *digestible* nutrients. There is, hence, a considerable discrepancy between their figures and those given here.

Table II. gives the average cost per food unit of all the feeding stuffs quoted at all four markets. The figures, on

TABLE II.

Average Prices per Food Unit.

	s.	d.		s.	d.
Brewers' grains (wet) ..	1	3½	Rice meal, Burmese ..	2	3½
Ground-nut cake ..	1	4¾	Beans, English	2	3¾
Maize gluten feed ..	1	8¼	Wheat bran (broad) ..	2	4
Soyabean cake	1	8½	Wheat sharps	2	4½
Decorticated cotton cake	1	10	Linseed	2	5
Coconut cake	1	10	Cotton seed, Egyptian..	2	5¼
Brewers' grains (dried) ..	1	11½	Rice meal, Egyptian ..	2	5½
Linseed cake, Indian ..	2	0	Maize meal	2	6
Palm-nut kernel cake ..	2	0	Peas, English dun ..	2	6½
Linseed cake, English ..	2	1	Cotton cake, Egyptian	2	8¼
Malt culms	2	1¼	,, ,, Bombay ..	2	10
Wheat pollards	2	1¾	Peas, English maple ..	2	10½
Maize, Argentine.. ..	2	1¾	Oats, Argentine.. ..	2	11½
Maize germ meal ..	2	2	,, English	3	0
Beans, Chinese	2	2½	Feeding treacle	3	0½
Maize, American ..	2	2⅓	Barley, English feeding	3	2
Wheat bran	2	2½	Linseed oil	3	2
,, middlings ..	2	2¾	Peas, Calcutta white ..	3	3

comparison with those of last month, show a general advance in price of over 1*d*. per nuit. In some cases the advance is much greater, as follows: Linseed oil 4*d*., Argentine maize and maize meal 3*d*., maize germ meal, wheat middlings, Burmese and Egyptian rice meals, and English feeding barley 2½*d*., dried brewers' grains, palm-nut kernel cake, wheat bran (broad) 2¼*d*., and wheat sharps 2*d*. Peas, on the other hand, have decreased in price on the month, English dun by 4½*d*., and English maple by 2*d*. per food unit.

Table III., exactly the same as last month, gives the nutritive ratios, the percentages of digestible nutrients, and the starch and linseed cake equivalents of all the feeding stuffs quoted.

In the majority of cases there is no need to change the rations suggested in the notes for November and December. Two cases, however, call for special remark.

Milch Cows.—In the notes for November an error occurred in the allowance per gallon of milk which was suggested for milch cows. Unfortunately this error was not discovered until it was too late to correct it in last month's notes. The following standard ration was suggested for a cow of about 10 cwt. live-weight giving 2 gal. of milk per day :—

Roots	56 lb.
Hay	8 ,,
Straw	12 ,,
Bran	3 ,,
Linseed cake	1 ,,
Cotton cake	1 ,,

It was then suggested that 2 lb. extra *concentrated food* should be added to the ration for each extra gallon of milk above

TABLE III.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Per cent. digestible.				
Name of Feeding Stuff.	Nutritive Ratio.	Protein.	Fat.	Carbo-hydrates and Fibre.	Starch equiv. per 100 lb.	Linseed Cake equiv. per 100 lb.
			Foods Rich in both Protein and Oil or Fat.			
Ground-nut cake	1 : 0·8	45·2	6·3	21·1	77·5	102
Soya bean cake	1 : 1·1	34·0	6·5	21·0	66·7	88
Decort. cotton cake ..	1 : 1·2	34·0	8·5	20·0	71·0	93
Linseed cake, Indian ..	1 : 1·9	27·8	9·3	30·1	77·1	101
Linseed cake, English ..	1 : 2·0	26·7	9·3	30·1	76·0	100
Cotton cake, Egyptian ..	1 : 2·1	15·5	5·3	20·0	40·0	53
Cotton cake, Bombay ..	1 : 2·5	13·1	4·4	21·5	37·6	49
Maize gluten feed	1 : 3·0	20·4	8·8	48·4	87·4	115
Brewers' grains, dried ..	1 : 3·5	14·1	6·6	32·7	50·3	66
Coconut cake	1 : 3·8	16·3	8·2	41·4	76·5	101
Palm-nut kernel cake ..	1 : 4·0	12·5	7·7	32·0	63·0	83
Linseed	1 : 5·9	18·1	34·7	20·1	119·2	157
			Fairly Rich in Protein, Rich in Oil.			
Maize germ meal	1 : 8·5	9·0	6·2	61·2	81·0	107
Rice meal	1 : 9·4	6·8	10·2	38·2	68·4	90
			Rich in Protein, Poor in Oil.			
Peas, Calcutta, white ..	1 : 2·1	23·3	1·1	45·9	66·9	88
Beans, English	1 : 2·6	19·3	1·2	48·2	67·0	88
Beans, Chinese	1 : 2·6	19·6	1·7	47·9	67·0	88
Peas English maple ..	1 : 3·1	17·0	1·0	50·0	70·0	92
Brewers' grains, wet ..	1 : 3·5	3·5	1·5	8·6	12·7	17
Malt culms	1 : 3·6	11·4	1·1	38·6	38·7	51
			Cereals, Rich in Starch, not Rich in Protein or Oil.			
Barley, feeding	1 : 8·0	8·0	2·1	57·8	67·9	89
Oats, English	1 : 8·0	7·2	4·0	47·4	59·7	79
Oats, Argentine	1 : 8·0	7·2	4·0	47·4	59·7	79
Maize, American	1 : 11·5	6·7	4·5	65·8	81·0	107
Maize, Argentine	1 : 11·3	6·8	4·5	65·8	83·5	110
Maize meal	1 : 13·0	5·5	3·5	63·9	77·8	102
Wheat middlings	1 : 5·3	12·0	3·0	56·0	59·1	78
Wheat sharps	1 : 5·0	12·0	4·0	50·0	58·4	77
Wheat pollards	1 : 5·3	11·6	3·5	53·0	54·1	71
Wheat bran	1 : 4·7	11·3	3·0	45·0	49·7	65
Wheat bran, broad ..	1 : 4·7	11·3	3·0	45·4	48·1	63

2 gal. per day. This clearly suggests that the extra allowance per extra gallon is 2 lb. of the above mixture of bran, linseed cake, and cotton cake, which is not a sufficient allowance. The custom at Cambridge, however, is to give all the cows 3 lb. of bran, and for each extra gallon to give an extra allowance of 2 lb. of mixed cotton and linseed cake. It is desired to thank Mr. J. Mackintosh, Lecturer in Dairy Husbandry at University College, Reading, for pointing out the error, which it is hoped has not caused inconvenience to those who may have used the ration.

At present prices one of the following mixtures may be used with safety and considerable economy to replace an equal weight of mixed linseed and cotton cakes :—

I. Maize gluten feed, dried grains, coconut cake and ground-nut cake, in equal parts.
II. Decorticated cotton cake 3 parts, crushed maize 2 parts.
III. Ground-nut cake, coconut cake, and rice meal, 1 part of each.

For the sake of clearness the full ration may be repeated :—

Roots	56 lb.
Hay	8 ,,
Straw	12 ,,
Bran	3 ,,
Mixtures I., II., or III.	2 ,,

This ration is suitable for a cow of about 10 cwt. live-weight giving 2 gal. of milk per day. Larger cows should get a ration larger by one-tenth for each increase of 1 cwt. in live-weight. The ration for smaller cows should be decreased in the same proportion. For each extra gallon of milk above 2 gal. an extra 2 lb. of the concentrated food mixture I., II., or III., should be added to the ration.

For Ewes Lambing on Roots.—The following mixtures are suggested :—

I.	Cotton cake	2 parts.
	Linseed cake	1 part.
	Maize	2 parts.
	Beans	1 part.
II.	Cotton cake	2 parts.
	Linseed cake	1 part.
	Dried grains	3 parts.
III.	Cotton cake	2 parts.
	Linseed cake	1 part.
	Mixed home-grown corn, crushed	3 parts.

If the roots are sound and good and the ewes show no sign of scouring, the cotton cake may be reduced and the linseed cake increased.

It has not been considered justifiable to suggest the use of any of the cheaper less-known cakes, because of want of experience of their use for suckling ewes. It is proposed, however, to try the following mixture for ewes at the Cambridge farm, and as there seems no reason why it should not be successful, it is mentioned in case others may care to try it for the sake of economy :—

Ground-nut cake	2 parts.
Mixed home-grown corn ..	3 ,,

The intention is to introduce the ground nut-cake gradually in place of the linseed and cotton cake mixture, and watch the lambs for any sign of scouring or other disturbance of health, and revert, if necessary, to the linseed and cotton-cake mixture.

For Early Lambs with Ewes on Roots.—For early lambs feeding out of trough creeps in front of their mothers the following mixtures are suggested :—

I. Ground linseed and maize (1 to 5) ..	1 part.	II. Linseed cake ..	2 parts.
Bran	1 ,,	Bran	2 ,,
Beans	1 ,,	Oats	2 ,,
		Beans	1 part.
		Malt culms ..	1 ,,

The cheaper less-known cakes are not suggested in case they should not suit young lambs, and cause a check in their progress which would preclude all chance of profit.

Successful Employment of Women on Farms.

SEVERAL instances of the successful employment of women on farms have recently come to the notice of the Board. On a 500-acre farm near Coventry, the occupier, Mr. V. R. S. Vickers, obtained 8 girls through the Birmingham Labour Exchange, none of whom had previously done any farm work, and 4 of whom had never even done any manual labour. Of these 8, two left after a few weeks (during which time they had done good work), and one more left after harvest, as a previous illness had made her unfit to face the winter weather. The remaining 5 stayed until the Christmas holidays, and some, if not all, will be returning shortly.

The women have side-hoed and singled roots, topped and carted them, hoed, lifted and clamped potatoes, helped thresh, helped with hay and harvest, whitewashed sheds, mended bags, harrowed before and after drilling, cut thistles, carted manure, and in fact have taken part in nearly all the farming operations which were carried on during the time they were on the farm, with the result that Mr. Vickers

Photograph of a Group comprising the Farmer and Workers on a 500-Acre Farm near Coventry.

expresses himself as being more than satisfied with their work and with the keenness they have displayed. It may be of interest and help to farmers intending to employ women to know that on this particular farm the girls lived in two cottages. Four provided their own furniture, and the other 4 had the cottage furnished for them, but in both cases they had only the absolutely necessary things. They, of course, did their own housework and house-keeping.

Mr. Vickers formerly employed 11 men, but latterly had 6 men, 5 girls and 1 boy (freed from school owing to the war), and he hopes to obtain the services of 1 or 2 additional women. He finds that at most work 3 unskilled girls are able to do the work of 2 ordinary farm men. The men work from 6 a.m. to 6 p.m., and the girls from 6.30 a.m. to 6 p.m., while, in addition, the latter have always been allowed reasonable time off (for which they are not paid), to do their shopping, etc. Men and girls are, of course, paid overtime for hay-making and harvesting. The girls, as beginners, received 15*s.* per week and a share of a cottage, with 4*d.* per hour for overtime. They were allowed ½-hour for breakfast, 1 hour for dinner, and when working overtime, but not otherwise, ½-hour for tea. All those who return after the holidays will have a rise in wages, as they will be more efficient; beginners will start at the original wage.

Mr. Vickers states that he applied for women workers because he was very short-handed, but candidly admits that he did not expect that they would be much good. Now, however, he cannot speak too highly of them.

A tenant on a farm at Staverton, Devon, was able in 1915 to save the produce of his orchards, which are 30 acres in extent, by employing women. One of these women pickers, although 65 years of age, earned £5 in 1914 and £10 in 1915 at apple picking, the remuneration being 2½*d.* per bag of approximately 1 cwt. picked.

On the same farm a lady, who lived in the village two miles away, did very useful work at swede hoeing, in spite of the fact that she had had no previous training.

In another case, on a Warwick farm, the daughter of a country vicar has worked for over a year doing all sorts of farm work, ploughing included, in a thoroughly satisfactory manner.

The Cumberland and Westmorland Travelling Dairy School.

THE accommodation provided in connection with travelling dairy schools for the purposes of instruction and demonstration consists usually of an ordinary tent. An excellent arrangement has, however, been adopted by the Cumberland and Westmorland Travelling Butter-making School which might with advantage be considered in other counties.

The van, which carries the equipment of this School from place to place, is specially constructed so as to form part of the instruction tent. The van is 15 ft. long by 7 ft. wide, the height from the ground to top rail is 12 ft., and the height without the wheels and springs is 9 ft. 2 in. The floor of the van can be extended by 1 ft. 9 in. in width on each side. To permit of this, the sides are removable; one side is refitted on the extended van flooring, while to the other side a tent is attached.

The attached tent is 30 ft. long, and of the same height and width as the van; the canvas is supported by a light frame, which is in turn supported partly by being attached to the van, and partly by a pole fitted in the centre of the annex, and another at the further end. The flooring of the annex is made with racks 7 ft. 6 in. long by 2 ft. wide, constructed of 3-in. by $\frac{7}{8}$-in. laths on 3-in. by $1\frac{1}{2}$-in. bearers.

In this way the van forms one end of the enclosure, which is large enough to accommodate a class of 14 students; the van also serves as a platform for visitors when the students in the annex are engaged on practical work. The van has a steadying influence on the canvas annex, enabling the latte to withstand strong winds.

The van can be moved either by horses or by an engine, its weight, when loaded with full equipment, being 3 tons 18 cwt., the weight of the flooring and frame of the tent annex accounting for 16 cwt. of this.

The accompanying photograph shows the van extended, and with the tent attached.

This Travelling Butter-making School works for one part of the year in Cumberland, and for the other part of the year in Westmorland, and it reaches districts remote from populous centres. As already stated, it accommodates 14 students, and when visited in the early summer of last year it possessed its full complement of scholars, all of whom were females directly engaged in agriculture, and all of whom had made full attendance up to the time of the visit.

Travelling Dairy Van of the Cumberland and Westmorland Travelling Dairy School.

As the School possesses only 7 sets of apparatus for butter-making, the course is divided into two halves; in the first half the students work in pairs; while in the latter half arrangements are made by dividing the class into two sections, for each scholar to have the independent use of a set of apparatus, the hours for the practical work of the two separate sections being fixed so as to permit of a 45-minute interval for a theory class for the whole 14 students to be held.

During the stay of the School at each centre the instructress pays visits to the students' own dairies for the purpose of giving advice. An examination is held at the end of the course by the Principal of the Cumberland and Westmorland Farm School, Newton Rigg, and awards of certificates are made on the results; further, deserving students are recommended by the instructress for scholarships at the Farm School.

The entrance fee for students to the Travelling Dairy School is 2*s*.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

The "Benefactor" Variety of Wheat.—The November issue of this *Journal* contained (p. 807) a summary of a report on varieties of wheat tested at Garforth in 1915, in which it was stated that while both yield and quality of grain of Benefactor Wheat were excellent, it seemed not unlikely, in the opinion of the writer of the report, that the hairs with which the glumes are covered would tend to make the ears hold water in a wet harvest, and that the grain would quickly sprout in the stook in wet weather.

The attention of the Board has been called by Messrs. Gartons, the introducers of this wheat, to the remarks in their catalogue respecting "Benefactor" based on extensive experience of the variety, to the effect that—"In the wet harvests of 1908 and 1912, when many smooth-chaffed wheats were badly damaged in our plant-breeding grounds through sprouting, not a grain of this new breed was spoiled. The reason is that the hairs hold off all moisture from the chaff, thereby preventing its being absorbed by the ear, and allowing it to be easily dried off by the wind." Messrs. Gartons also quote Vilmorins' book on wheats to the same effect in respect of velvet-chaffed varieties in general, the conclusion being that the hairs on the glumes of such varieties are a benefit rather than a disadvantage.

The Board are anxious that any comments on varieties of crops

* A summary of all reports on agricultural experiments and investigations recently received is given each month. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.

which appear in their *Journal* should convey a correct impression of their merits. The statement made in the issue for November represented the opinion of the writer of the report, and, also, it may be added, of many practical farmers, but in view of the experience of Messrs. Gartons, the Board have communicated with the Department of Agriculture of the University of Leeds, with the result that Professor Seton agrees to the publication of Messrs. Gartons' comments on the opinion expressed in the report.

Varieties of Wheat (*Salop C. C. Rept. No.* 2, 1915).—Trials of wheat varieties were made at five centres on various types of soil in 1915. The average yields in bushels of 63 lb. were as follows:—Standard Red 34¼ (4 centres); Browick Grey Chaff 32¾ (5 centres); Little Joss 27½ (4 centres); Svalöf Square Head 27 (5 centres); Squarehead's Master 24¾ (3 centres); White Chaff Square Head 24¼ (4 centres). It is stated that the results do not conform closely to those of the previous year, and it is not desirable at present to draw conclusions, except that it appeared to be unwise to sow the varieties tested later than the first week in November.

Varieties of Oats (*Edinburgh and E. of Scot. Coll. of Agric., Rept. Lft., Ser. B., No.* 1).—In 1914 thirteen varieties of oats were grown following a potato crop, and received a dressing of 1 cwt. sulphate of ammonia, 3 cwt. superphosphate and 1 cwt. potash salts per acre. The plots were each of ½ acre, but the newer varieties were grown in duplicate, and 4 plots of Potato oats were sown for purposes of comparison. The seed was drilled during the second week in April on the principle of an approximately equal number of seeds per acre for all varieties. The following table shows the yields per acre of dressed grain and straw in 1914, and the rate of seeding of the different varieties which has been adopted for the 1915 trials, based on a standard rate of 4·3 bush. of Potato oats per acre (representing some 2·6 million seeds):—

Variety.	Yield per acre, 1914. Dressed Grain.	Yield per acre, 1914. Straw.	Rate of Seeding per acre, 1915.
	Bush. (42 lb.)	Cwt.	Bush. (42 lb.)
Record	112·5	37·5	5·6
Crown	109·3	36·3	5·5
Leader	102·8	31·9	6·1
Victory	101·8	38·4	5·8
Banner	95·0	33·3	5·1
Wideawake	93·8	33·2	5·1
Abundance (Regenerated)	93·7	32·2	6.2
Beseler	93·0	31·0	6·3
Abundance (3 years from Garton)	92·5	31·2	6·2
Waverley	87·9	31·4	6·0
Golden Rain	87·0	30·6	4·8
Storm King	87·0	32·1	6·1
Yielder	86·4	32·5	6·2
Potato (average of 4 plots)	81·3	34·3	4·3

It was noted that when the crop of the respective varieties was good and equally thick on the ground, the excessive coarseness of the straw

of some of the new varieties was partly eliminated, and that stock ate it quite as readily as that of Potato oats. The remedy for inequality as regards straw texture appears to be adequate seeding, as suggested in the table.

Varieties of Barley (*Edinburgh and E. of Scot. Coll. of Agric., Rept. Lft., Ser. B., No. 1*).—Barley was grown in 1914 on a heavy loam which had borne a poor crop of turnips the previous season, the dressing per acre being ½ cwt. sulphate of ammonia, 3 cwt. superphosphate and 1 cwt. potash. The plots were each ¼ acre in extent, but the newer varieties were grown in duplicate and several plots of Maltster and Plumage were laid down as standards. The seed was drilled on 21st and 22nd April, an approximately equal number of seeds being sown for each variety, on an average 3½ bush. per acre. The yields of (1) dressed grain in bush., and (2) straw in cwt. per acre were as follows :—Plumage Archer 70·7, 36·8 ; Gold 70·3, 24·1 ; Princess 63·5, 40·1 ; Archer 61·8, 36·5 ; Binder 61·6, 36·7 ; Plumage 61·4, 37·1 ; Maltster 59·5, 33·3 ; Goldthorpe 58·6, 35·1 ; Chevalier 58·0, 34·1 ; Standwell 57·5, 35·7 ; Common 55·5, 34·6 ; Swanneck 53·8, 30·6 ; Primus 51·2, 32·7.

OFFICIAL NOTICES AND CIRCULARS.

THE President of the Board of Agriculture and Fisheries has addressed the following letter, dated 11th January, 1916, to the Mayors of Boroughs and County Boroughs in England and Wales :—

Production of Food on Allotments in Boroughs and County Boroughs.

SIR,—I ask permission to be allowed to draw your attention to the necessity of producing as much food as possible from allotments and garden grounds within the area of county boroughs and boroughs during the coming season. It is quite possible that the question has already been fully dealt with in your borough, and, if so, you would oblige me very much by informing me what steps have been taken, and with what success, as knowledge of what has been done in one area may be of considerable use and encouragement to others. If, however, the matter has not received special attention, then I suggest it might be useful that definite information should be obtained on such points as the following, either by calling a meeting of those likely to be interested, or by making enquiry of the secretaries of allotment and gardening societies, or by such other means as may seem to you to be appropriate :—

(1) Whether there is an unsatisfied demand for allotments in any part of the area for which your authority is responsible and, if so, would it be possible to provide the necessary land ?

(2) Whether owing to the absence of men on military service or munitions work any allotments are uncultivated or not fully cultivated and, if so, whether persons can be found who from patriotic motives would assist in cultivating the land?

(3) Whether there are any causes such as a deficiency of manure which are likely to prevent allotment holders from producing full crops and, if so, whether by co-operation among the allotment holders, or otherwise, supplies of manure could be secured?

I am hopeful that under present conditions the expert amateur or professional gardeners resident in every town in this country will be prepared to place their practical skill and experience at the disposal of any committee formed with the object of enabling artisans and others to make the fullest use of the land which they may occupy or of which they may obtain possession. My Department will, it is needless for me to say, be very glad to be of any assistance possible in the matter, and in this connection I may perhaps draw your attention to a leaflet* which outlines the measures which have been suggested with a similar purpose to villagers. It may be that the formation of a "*Borough* War Food Society" on the lines suggested in the leaflet would be a good method of attracting wide interest in a compaign to cultivate to the full all land available in the borough.

It would greatly aid the movement if a small fund were raised for the purpose of giving prizes for the best cultivated allotments, or for the best crops produced. I an aware that the general level of cultivation in many borough allotments in this country is already high, but I am convinced that a good deal more can be done to increase the production from them in this time when the nation needs every pound of food which it can produce within its borders.

I recognise that your time must at present be very much occupied with many kinds of public work, but in view of the great importance in the national interest of maintaining and, if possible, increasing our food supplies, I have thought myself justified in making this appeal directly to you.

I am, yours faithfully,

(Signed) SELBORNE.

---

* Refers to Special Leaflet No. 32 (*War Food Societies*); see also this *Journal*, December, 1915, p. 894.

The Application of Basic Slag to Grass Land.

FROM the information before the Board it appears that many farmers who desire to apply basic slag to grass land may have been unable, owing to difficulties of transport and other causes, to obtain a supply of this fertiliser. In these circumstances the Board think it desirable to call attention to the fact that while there are certain advantages in applying basic slag to grass land early in the winter, the season for the operation may properly be regarded as extending to the end of March. Should the spring months be wet even later applications may be effective next season.

Government Purchase of Grain.

IN connection with arrangements which are now being made for supplies of grain to the British and Allied Governments, Lord Selborne has appointed Sir George Saltmarsh to an important advisory and administrative post at the Board of Agriculture and Fisheries.

"Starred" Men, Etc.

AN official announcement issued on 17th December, 1915, states that against the names of men "starred," men authorised to wear a war work badge issued by the Government, and men actually engaged in a reserved occupation (lists of which have been published) a mark is placed on the Army Register.

Owing to the pressure in recruiting offices during the past few weeks, however, Lord Derby thinks it is not unlikely that in some cases the mark may have been omitted. He is anxious to avoid mistakes in respect of men in the above classes, and, when the groups are called up, if any man in those categories receives a notice calling him up for service, he should at once see his employer, who should forward the notice forthwith to the Recruiting Officer who issued it, together with a certificate signed by the employer, stating the precise occupation in which the man is actually engaged, and the name, address and business of the firm by which he is employed.

On receipt of these particulars the Recruiting Officer will provisionally cancel the notice calling up the man, and, if on investigation it is found that the statements made by the employer are correct, a mark will be placed in the Army Register against the name of the man. If the Recruiting Officer has reason to doubt whether the man is entitled to have a mark placed against his name in the Army Register, he will take steps to have the matter investigated by the Home Office, the Ministry of Munitions, or the Local Tribunal, as the case may require.

The strictest accuracy must be observed in statements by an employer as to the occupation in which the man is actually engaged. Cases of misrepresentation will be reported to the War Office.

"Starring" of Agricultural Workers.

THE following Circular Letter, dated 23rd December, 1915, has been issued by the Board to the Secretaries of County War Agricultural Committees on the question of the recruiting of agricultural workers:—

SIR,—I am directed by the President of the Board of Agriculture and Fisheries to state that he has had under consideration the steps which it is desirable for farmers to take in order to ensure that men in their employment who have been "starred" for the purpose of the National Register, or who, although engaged in a "starred"

occupation, have not been "starred," and who have been attested under Lord Derby's Scheme, are not called up with their Group, or, if called up through inadvertence, do not leave their employment to join the Colours.

In view of the extreme pressure experienced in many Recruiting Offices during the closing days of Lord Derby's Scheme, it is possible that a "starred" agricultural labourer may have been attested without a record having been kept and a note having been made in the Army Register of the fact that the man was "starred."

It may also happen that a man whose occupation entitled him to be "starred" in the National Register was in fact not so "starred," and has, therefore, not been noted as a "starred" man in the Army Register.

If, therefore, a man who has been "starred," or whose occupation entitles him to be "starred," receives a notice paper (Army Form W. 3195) to present himself for service with the Colours, the assumption is either that the man was not "starred" on the National Register or that the Recruiting Officer has failed to note the fact in the Army Register. In such cases the farmer or employer, unless he can immediately adjust the matter with the Military Authorities, should at once apply to the Local Tribunal for a declaration that the man should be treated as "starred." For this purpose he should obtain from the Secretary to the Local Tribunal a copy of the Forms R. 13 and R. 14, and should return them duly filled in before signing the statement mentioned below.

The calling up of a Group will be publicly notified about a month in advance by the exhibition of posters by the Military Authorities. About a fortnight later individual notice papers (Army Form W. 3195 above referred to) will be addressed to the men who are actually being summoned to the Colours. Farmers who have "starred" men, or men engaged in "starred" occupations in their employ, are recommended, as soon as the posters in question are exhibited, to call the attention of such men to the fact that the calling up of a Group does not affect "starred" men. The farmer should also instruct any such employés who may later on receive a notice paper of summons to the Colours (Army Form W. 3195) at once to bring it to him.

In accordance with the official notice published in the Press on 17th December,* a copy of which is enclosed, it will be open to employers, including farmers, in the case of any "starred" men called up through inadvertence, to return the notice paper to the Recruiting Officer with a signed statement giving the reason why the man in question should not have been called up for service. Such a statement might conveniently be in the enclosed form.†

Lord Selborne would be obliged if your Committee would be good enough to give the widest publicity among farmers to this information, and additional copies of the Circular and of the enclosures will be supplied to you if required.

I am to add that as Groups 2 to 5 have already been called up, and as the appeal to the Local Tribunal for a declaration that a particular man employed in a "starred" occupation but not "starred" should be treated as a "starred" man must be lodged, as regards men included in such Groups, before the 30th instant; the matter so far as it affects such men is very urgent.

I am, etc.,

SYDNEY OLIVIER, *Secretary*.

* See p. 1013. † Not here printed.

THE following Circular Letter, dated 29th December, 1915, has been addressed to Secretaries of County War Agricultural Committees :—

Agriculture and Recruiting.

SIR.—I am directed by the President of the Board of Agriculture and Fisheries to say that the question has been raised by several War Agricultural Committees as to whether they and their District Committees would have any right to appear before the Local Tribunals, which have been set up by the Local Government Board, when questions in connection with the "starring" of skilled agricultural labourers, the indispensability of particular employees, etc., are under consideration by the Tribunals.

Lord Selborne desires me to say that whilst the County Committees or their District Committees have not the right to appear before the Local Tribunals, he sees no reason why they should not bring to the notice of those Tribunals in writing any facts which they may consider of importance bearing on the particular cases of the kind which are about to be heard and considered by the Tribunals, but it is entirely a matter for the Local Tribunals to decide how far consideration should be given to such representations.

With reference to paragraph 4 of the Memorandum, Agriculture and Recruiting, dated the 23rd ultimo,* copies of which have already been supplied to you, indicating the procedure to be adopted in the case of a man who although actually engaged in a "starred" occupation has not been "starred," Lord Selborne understands that some misapprehension exists as to whether it is necessary for a man to have been attested before an application can be made to the Local Tribunal in the manner indicated in the paragraph referred to. Lord Selborne desires me to state for your Committee's information that in a Circular issued by the Local Government Board on the 10th instant, No. R. 18, it is definitely laid down that such application may be made to a Local Tribunal whether a man has been attested or not.

I am to add that the Local Government Board's Circular itself does not contain any other information which would be of use to your Committee, and for this reason copies are not being sent to you, but I am to enclose a Supplementary List of Reserved Occupations† which was enclosed in the Circular above referred to. You will observe that foremen in all departments of Fruit, Hop, and Market Gardens, and certain employees connected with the Milk trade, are included in the list.

I am, etc.,

SYDNEY OLIVIER, *Secretary.*

Notes on Fertilisers.

The following notes with reference to the position as regards various kinds of fertilisers have been prepared by the Committee appointed by Lord Selborne to make arrangements with a view to the maintenance, so far as possible, of adequate supplies of fertilisers for the use of farmers in the United Kingdom (see *Journal*, November, 1915, p. 811).

Nitrate of Soda.—Difficulties have arisen in procuring freight for the transport of Nitrate of Soda to this country. Farmers are advised to make arrangements to obtain their supplies for Spring use through the ordinary channels without delay. A notice which has been issued to the Press on this subject appears at p. 1018.

---

* This *Journal*, December, 1915, p. 903. † Not here printed.

Sulphate of Ammonia.—Arrangements were made by the Committee for a supply of sulphate of ammonia to be reserved for the use of farmers during November and December, 1915, at a fixed price. The question of the supply for Spring use is now under consideration by the Committee, and it is hoped to make an announcement shortly.

Owing, however, to the shortage in the supply of sulphuric acid, makers of sulphate of ammonia are experiencing difficulty in maintaining their normal production. The use of nitre cake as a partial substitute for acid in making sulphate of ammonia is, however, under consideration.

Basic Slag.—As regards basic slag, the position is that while there is probably in the aggregate a sufficient production, great difficulties are being experienced in securing delivery. Representations have been made by the Board to the Board of Trade and the Railway Executive Committee, and it is believed that the railway companies are making every effort to deal with the existing traffic, but the transport requirements of the military authorities and the shortage of labour make their position difficult.

The increased production of shell steel has, however, had an effect on the proportion of phosphoric acid contained in the raw slag, so that there is a much smaller supply of high-grade basic slag than hitherto.

Superphosphate.—The supply of superphosphate is being affected at the present time by the shortage in the supply of sulphuric acid referred to above, and a reduction in the production of superphosphate owing to this cause seems unavoidable. A method of equalising the effect of the demand for acid among the different makers of superphosphate is under consideration.

Export.—The export of nitrate of soda is prohibited to all destinations, and no exceptions to this requirement are allowed.

The export of superphosphate, raw phosphate, basic slag, bones, bone meal, guano, sulphate of ammonia and potash is prohibited to all destinations other than British Possessions. No licences are being issued for the export of phosphate, superphosphate, basic slag or potash, but occasional applications for other articles are agreed to for special reasons.

With regard to the export of sulphate of ammonia, attention is drawn to a letter from Mr. Acland which appeared in "The Times" of the 22nd December, 1915, and which is printed below.

Early Delivery.—The Fertilisers Committee desire to impress upon farmers the importance of ordering their fertilisers and all other requirements well in advance in order to allow both for delays in transit and for difficulties in supply. At present a further rise in the price of all fertilisers seems probable.

Exportations of Sulphate of Ammonia.

THE following letter, dated 22nd December, 1915, has been addressed to the Editor of *The Times* by the Chairman of the Committee on Fertilisers with reference to an Article which appeared in that paper on the 20th December last, headed "Feeding Stuffs for Neutrals—Farmers' Suspicions," in which it was suggested that the agricultural industry was being prejudiced by the special exportations of sulphate of ammonia which the Government were allowing :—

SIR,—The article in *The Times* of the 20th December last, under the

heading of " Feeding Stuffs for Neutrals " deals at some length with the subject of sulphate of ammonia. As I am the chairman of a Committee appointed by the President of the Board of Agriculture and Fisheries to take such steps as may be possible and advisable to ensure an adequate supply of fertilisers for the use of farmers, you will perhaps allow me to make one or two comments on the statements of your Agricultural Correspondent.

With the opinion that the farming interest has a right to claim that not a ton of fertilisers or feeding stuffs should be allowed to be exported until home requirements are fnlly met, I cordially agree, and I may add that this is precisely the policy which the Board of Agriculture has adopted since the outbreak of war. On the other hand, I deny with confidence the allegation that the claims of agriculture are, or have at any time been," set aside in an unintelligible desire to propitiate either commercial or foreign interests." The Board arranged in August, 1914, to collect monthly returns of the stocks of feeding stuffs and fertilisers, as well as of food-stuffs in the United Kingdom, and these returns have enabled us to watch very closely the actual supplies available from time to time. Only when the Board have been satisfied not only by the returns of stocks in hand but also by prospects of future supplies that the requirements of farmers were fully provided for, have they assented to exports.

It wonld, however, be of interest if your correspondent would indicate more clearly what he means by a full provision for home requirements, particularly in the case of sulphate of ammonia, which he selects as an example. The normal output of sulphate of ammonia is about 400,000 tons per annum, and the normal exports are about three-fourths of the total, a considerable proportion of the remainder being used for industrial purposes. Is it suggested that farmers would use what must be considerably more than four times their usual quantity if exports were entirely prohibited ? This would involve their spending about six million pounds on this one artificial manure—which is really unthinkable in the present agricultural circumstances. Or is it suggested that the same quantity would be produced if the market were restricted to the home demand ? It is true that sulphate of ammonia is to a large extent a by-product of gas making. But I understand that it is possible to make gas and at the same time considerably to reduce the production of sulphate of ammonia, and that this might be done if the supply were to exceed the demand over any considerable period. In that case the price of gas would rise, and the farmers would get no more fertiliser. This aspect of the matter is worth consideration by those who advocate prohibition of export, not so much in order to secure ample supplies, but in order to lower prices. The effect of prohibition of export upon the Scottish shale-oil works and the coke ovens of the North of England ought also to be considered. Subject to the farmers' supplies being ample, the position of such industries is surely a matter for thought and attention.

With regard to supplies, the Committee proposes to act in the future on the same general lines as in the past—namely, by an arrangement with the makers of sulphate of ammonia to reserve month by month an ample supply for agricultural requirements, and to assent to the export from time to time only of such quantities as are shown to be in excess of all home demands. Farmers have an entirely reasonable expectation of being able to obtain during the coming months an ample

supply of all fertilisers which can be produced here in sufficient quantities. This expectation should not be encouraged to degenerate either into a groundless belief that such supplies will not be available, or into an unreasoning demand that all exports should be stopped—however ample the supplies may be which will be retained here. The farming community would show that good sense which, if I may say so, has generally characterised their attitude during the war, by looking into this question in the light of the available facts and figures, rather than by agitating in the manner which your correspondent suggests, *without having the essential outlines of the subject before them.*

Your obedient Servant,
(Signed) F. D. ACLAND.

Nitrate of Soda from Chile.

ON 22nd December last the President of the Board of Agriculture and Fisheries announced to the Press his regrets, that in consequence of the exceptional demands for freight it had not yet been found possible to arrange for the shipment of nitrate of soda from Chile as was contemplated.

Maintenance of Live Stock Order. 1915.

THE following Circular Letter, dated 22nd December, 1915, has been issued by the Board to the County Councils, Borough Councils (including Metropolitan Borough Councils) and District Councils in England and Wales, on the subject of the Maintenance of Live Stock Order, 1915:

SIR,—I am directed by the President of the Board of Agriculture and Fisheries to refer to the Board's Circular Letter of the 21st August last on the subject of the Maintenance of Live Stock Order of 1915, and to say that as the Order has now been in operation for four months, Lord Selborne wishes to obtain information as to the action taken by the various Local Authorities who were authorised to enforce the Order.

In the final paragraph of the letter of 21st August, Lord Selborne expressed the opinion that it would probably be possible for the Local Authorities to secure by means of their existing officers a general observance of the restrictions on slaughter imposed by the Order, and he would be glad to know whether this opinion has been borne out by results so far as your Council is concerned. In this connection I am to enquire what, if any, action has been taken by your Council

(1) To secure the branding of calves at auction marts in accordance with the conditions prescribed by Art. 2 (3 & 4) of the Order;
(2) To prevent the illegal branding of calves by persons other than the auctioneer or his representatives; and
(3) To prevent the slaughter of unbranded calves under the age of six months which are not out of cows of the dairy breeds exempted under Art. 2 (2) of the Order.

Lord Selborne wishes also to be informed whether special steps have been taken by your Council to appoint Inspectors to secure the observance of the Order in regard to the slaughter of calves at any abattoirs or slaughter-houses in your district, and he will be glad if you will be good enough to furnish a reply to this letter as soon as possible.

I am, etc.,
SYDNEY OLIVIER, *Secretary.*

Home Grown Timber Committee.

THE President of the Board of Agriculture and Fisheries appointed early in December a Committee for the purpose of making such arrangements as are likely to ensure the fullest use being made of native resources in supplying existing demands for timber.

The Committee are prepared to purchase standing timber and to make arrangements where necessary for felling, hauling and conversion ; they will be glad to receive particulars of timber which landowners and others would be willing to sell for Government purposes.

The Committee have received a very large number of offers of timber which are being dealt with as rapidly as possible. Any lots which are *prima facie* suitable for the Committee's purposes will be inspected as soon as the pressure upon the Committee's staff will permit.

Meanwhile, it may be of service to landowners, agents and others to know that the classes of growing timber at present principally required by the Committee are :—

Scots and Corsican pine, silver fir, Douglas fir and larch of good dimensions and in lots of about 20,000 cubic feet and upwards.

Plantation ash of fair size, which will be accepted in comparatively small lots.

Other hardwoods of good dimensions are also required, but, as a rule, these can not be considered in small lots.

The Committee are also prepared to enter into arrangements with the owners of estate sawmills or the conversion of timber. The Committee would be glad to be informed of sawmill plant that is idle or not fully employed, in order that, if possible, arrangements may be made for increased output.

All communications for the Committee should be addressed to the Secretary, Home Grown Timber Committee, Craven House, Northumberland Avenue, London, W.C.

Examination of Tithe Maps.

THE President of the Board of Agriculture and Fisheries gave notice on 18th December last that in consequence of depletion of the Board's staff the Inspection Room for the examination of Tithe Maps, etc., at the Board's Office at 3, St. James's Square, London, S.W., would be open, on and after 1st January, 1916, from 10 a.m. to 1 p.m. only. The fee for inspection has been raised to 2*s*. 6*d*.

Royal Botanic Gardens, Kew.

ON and after 1st January, 1916, the following fees are being charged, in the interests of national economy, for admission to the Royal Botanic Gardens :—

On Mondays, Wednesdays, Thursdays, Saturdays, Sundays and Good Friday, 1*d*.

On Tuesdays and Fridays, except Good Friday (Students' Days), 6*d*.

A charge of 3*d*. is made for the admission of photographic apparatus.

Bath-chairs will be permitted to enter the Gardens during public hours when the condition of the paths is suitable, on payment of 1*s*. on Students' Days (Tuesdays and Fridays, except Good Friday) and on payment of 6*d*. on other days.

Students' Permits, available till the close of the calendar year and obtainable on written application to the Director by *bonâ fide* students

and artists, will be issued on payment of a fee of 5*s*. These permits will cover free entrance on Students' Days and before public hours on week-days, except Good Friday and Bank Holidays.

Season tickets, available till the close of the calendar year, can be obtained on written application to the Director on payment of a fee of £1. These tickets will cover admission on any day during public hours.

THE following Leaflets have been issued in the ordinary series since the date of the list contained on p. 373 of the *Journal* for July, 1915:—

Leaflets in 1915.

No. 287.—*Diseases of Peas.*
No. 289.—*A Disease of Wheat.*
No. 292.—*Foot-and-Mouth Disease.*
No. 293.—*Soil Analysis.*
No. 300.—*The Breeding of Useful Pigeons.*
No. 301.—*Rabbit Breeding for Small Holders.—Housing and General Management.*
No. 302.—*Silver Leaf in Fruit Trees.*
No. 304.—*Husk or Hoose in Calves.*
No. 305.—*The Selection of Poultry for Breeding Stock and the Hatching of Chickens.*

In addition, the information in the following Leaflets has been revised and brought up to date:—

No. 9.—*Ensilage.*
No. 23.—*Potato Disease.*
No. 41.—*Red Spiders.*
No. 64.—*White Root Rot.*
No. 67.—*Favus or White Comb in Poultry.*
No. 80.—*Use of Artificial Manures.* This Leaflet has been extensively revised. A section giving suggested mixtures of manures for each crop has been added.
No. 93.—*Farmyard Manure.*
No. 108.—*Epizootic Abortion in Cattle, or Slipping Calf.*
No. 109.—*Cabbage Moth.*
No. 114.—*Feeding of Poultry.*
No. 122.—*Cabbage Root Fly.*
No. 129.—*Winter Egg Production.*
No. 160.—*The Cultivation of Lucerne.*
No. 192.—*Farm Butter-making.*
No. 201.—*The Marketing of Poultry.*
No. 229.—*The Breeding and Rearing of Turkeys.*
No. 235.—*The Organisation of the Milk Supply.* This Leaflet has been re-written.
No. 250.—*Fruit Bottling for Small Holders.*
No. 282.—*Scheme for the Improvement of Live Stock.*
No. 283.—*Storage and Disposal of Apples and Pears.* (Formerly Special Leaflet No. 6.)
No. 299.—*Harvesting and Storing of Garden Vegetables.* (Formerly Special Leaflet No. 15.)

A number of Special Leaflets have been issued since the date of the last list given (October, 1915, p. 698). The numbers and titles are as follows:—

Special Leaflet No. 35.—*Transport of Agricultural Produce.*
" " No. 42.—*Potash Supplies during the War.*
" " No 43.—*Suggestions for Saving Labour.*
" " No. 45.—*Calf Rearing.*
" " No. 46.—*Top Dressing Wheat in Autumn.*
" " No. 47.—*The Use of Straw for Fodder.*
" " No. 48.—*Compound Manures.*
" " No. 49.—*The Selection of Wheats for Spring Sowing.*
" " No. 50.—*Growing Two Corn Crops in Succession.*

Welsh translations of Special Leaflets No. 26 (*Suggestions to Allotment Holders for General Cropping during the Spring and Summer Months*), and No. 28 (*Suggestions for the Cultivation of Catch Crops and Home Grown Feeding Stuffs*) have been issued, while a Leaflet in Welsh containing information as to growing wheat in Wales has been published as Special Leaflet No. 7 (Welsh translation).

The following Special Leaflets have been revised and brought up to date :—

Special Leaflet No. 1.—*Suggestions to Allotment Holders for Autumn Treatment of Land.*
" " No. 2.—*Notes on Poultry Feeding.*
" " No. 5.—*Fruit Preserving for Small Market Growers or for Domestic Use.*
" " No. 8.—*The Utilisation of Cereal Offals and certain other Products for Feeding Purposes.*
" " No. 25.—*Technical Advice for Farmers.*
" " No. 32.—*War Food Societies.*

Bound Volumes of Leaflets.

A THIRD *Bound Volume* of Leaflets, containing Leaflets Nos. 201 to 300, was issued towards the close of 1915 at the same price as the first two bound volumes, viz., sixpence net, post free.

Revised editions of the Bound Volumes No. 1 (Leaflets 1-100) and No. 2 (Leaflets 101-200) have also been published. These volumes are, respectively, the twelfth and fifth editions.

Foot-and-Mouth Disease.

No outbreak of foot-and-mouth disease has been confirmed up to 11th January in any part of Great Britain subsequently to those mentioned in the notice contained in last month's *Journal.* The last outbreak in the Bradford-on-Avon District was confirmed on the 4th December and in the Glastonbury District on the 6th December. The restrictions imposed on account of foot-and-mouth disease in those districts have accordingly been further modified from time to time, and on the 12th January, the Board issued an Order coming into operation on the 14th January withdrawing all existing restrictions.

Local Restrictions on Poultry Keeping.

IN the event of the occurrence of any difficulty in the keeping of poultry, due to the operation of a by-law under the Public Health Act, 1875, dealing with this subject, the matter should be brought to the notice of the Local Authority, who, if they think it desirable, can apply to the Local Government Board for confirmation of an amending by-law. Should representations to the Local Authority prove unsuccessful the Local Government Board would, subject to the maintenance of such requirements as are necessary to secure the objects of the Public Health Acts, be prepared to suggest that the Local Authority should amend the by-law so as to remove the difficulty.

MISCELLANEOUS NOTES.

Supply of Horses for Military Purposes.

ON 3rd August, 1915, Lord Selborne appointed a committee to consider and advise the Board of Agriculture and Fisheries what steps should be taken to secure the production and maintenance in England and Wales of a supply of horses suitable and sufficient for military purposes, especially on mobilisation.

The Committee state [Cd. 8134, price 3*d.*] that it must be admitted from the evidence of the War Office that the present position is a menace to the State, and that urgent necessity exists for the improvement of the horse supply, both in the interests of the nation generally, and of the army in particular.

The Board's light horse breeding scheme is examined by the Committee, and their recommendations are appended to a discussion of each section of the scheme.

Registration of Stallions.—The increasing voluntary registration of stallions is referred to; the Committee are of opinion that, in order to protect owners of registered stallions from the competition of owners of unsound horses, and to give mare owners a larger number of sound sires to select from, legislation should be introduced to require *compulsory* annual veterinary examination by the Board of all stallions that are travelled for a service fee or publicly exhibited for stud purposes.

Award of Premiums to Stallions.—The Committee consider that the provision of high-class stallions for service at a low fee is the most practical method of affording encouragement and of giving facilities to mare owners to improve the class of stock bred in the country. They see no eason at present to suggest any alteration of principle in the present system of awarding King's and Super-Premiums; but they recommend that the number of King's Premium stallions should be increased in 1916 from 50 to 60, and progressively to 150 so soon as stallions of sufficient merit are available, there being many parts of the country in which no premium stallion is available, while many of the stallions have to travel much too wide an ar a. They consider, however, that until stallions of King's Premium merit are available in sufficient numbers, the award of Board's P. emiums should be continued to snpply the deficiency, but only to stallions which have been inspected and approved by expert officers of the Board.

With a view of preventing the export of premium stallions which, in the opinion of the Board, are suitable for country service, they recommend that it should be a condition of the acceptance of a Premium that the Government should be given the first refusal to purchase if the owner of the stallion has an offer to sell abroad. Such condition is to remain in force for twelve months from the date of the award of the Premium, and change of ownership shall not nullify this condition.

The Committee attach much importance to a continuance of the present schemes of the Board for improving and encouraging the breeding of ponies, and they urge that ample funds should be provided for the purpose.

Brood Mare Scheme—The object of the Board's brood mare scheme is to supply farmers and others with useful brood mares which, when mated with thoroughbred stallions, may be expected to breed progeny of the weight-carrying type, the class of light horse that is most likely to pay its way. The Committee are in favour of a continuance of this

scheme in those counties in which it has proved a success—about eight or nine—but recommend that, in view of the difficulty of purchasing really good mares at an average price of £50, that amount should be raised to £75.

The Committee consider also that the Board should acquire some high-class mares and sell them through County Committees to breeders who undertake to stint them to registered stallions approved by the Board or County Committees so long as the mares breed satisfactorily. The purchase price for such mares could, it is stated, be made repayable over a period of three years or be paid at the time of sale, but in both cases it is suggested that it should be a condition of sale that the mares are not to be exported abroad without the sanction of the Board.

Purchase of Stallions by the Board.—One of the most important proposals made is that as to the purchase of stallions by the Board. The main object being to prevent the best country stallions being bought for use abroad, it is proposed that the horses so purchased by the Board, so long as they prove themselves to be successful sires, should not be allowed to leave the country. To give effect to this recommendation, the Committee consider that the Board should appoint a competent buyer who would make it his business to know of every horse in training that appears suitable for country service.

Attention is called to the abnormal number of thoroughbred colts which are being castrated at the present time owing to the partial suspension of racing. The Committee state that, should this practice be found on enquiry to be of really serious dimensions, the Board should be empowered to acquire such thoroughbreds, as would otherwise be cut, and as may be held by competent judges to be really suitable for the breeding of the horses of the quality and stamp required for military purposes by the army.

Prizes at Shows.—The provision of liberal grants for the purpose of awarding foal prizes and futurity prizes to mares from 3 to 8 years old at country shows is recommended, no foal being eligible for more than one prize in a year, and as regards mares no grants being paid except in respect of those which produce living foals the following year—the produce of a premium or registered stallion approved by the Board or a County Committee; the grants are recommended to supplement, and not replace, prizes already given at shows.

Purchase of Army Horses.—It is emphasised by the Committee that the present method of buying remounts gives no encouragement at all to the breeder and does not bring him into touch with the army buyers. It is recommended that the War Office should—

(1) Purchase a much larger number of horses in England and Wales.
(2) Increase their horse peace establishments.
(3) Purchase more horses direct from breeders.
(4) Purchase remounts when rising four.
(5) Purchase specially selected fillies and leave them with breeders until they have produced and reared foals.
(6) Draft from the ranks at ten years of age mares which appear to be specially suitable for breeding purposes and transfer them to the Board for disposal under their brood mare schemes.

With regard to horses suitable for *artillery* and *light draught* it is recommended that steps should be taken by the War Office and the Board to encourage the improvement of that type of horse on light land and in the hilly districts.

The exportation of horses is not objected to provided that effective steps are taken to secure the retention of suitable stallions and mares in sufficient numbers for use in this country.

Other recommendations of the Committee are that arrangements should be made for a compulsory annual census of horses in as detailed a form as possible, and for more complete returns of horses exported and imported; that the Advisory Council and County Committees should be reconstituted; that an expert staff of officers should be appointed to supervise the horse-breeding scheme; and that the provision of funds for financing the scheme should be borne on the Board's Vote, and that encouragement of horse breeding should be recognised as a permanent activity of the State.

In conclusion, the Committee state that they are aware that the adoption of their proposals will involve very considerable expenditure—and a progressively increasing one for a few years—but even if it eventually approximates an annual outlay of £100,000 the amount would be small compared with that expended by many Continental Powers, or with the sum that would be required if it were found necessary for the War Office to set up establishments for breeding remounts.

Reservations and a supplementary report are made by the Rt. Hon. Henry Chaplin, M.P.

Import Regulations.

Plant Import Regulations, New Zealand.—The Board have received from the Colonial Office copies of new regulations dated the 23rd August, 1915, governing the entry of plants, etc., into the Dominion of New Zealand.

Plants or portions of plants (except grape vines or portions thereof) may be introduced into New Zealand from this country provided that every shipment is accompanied by one or other of the following certificates:—

(1) A certificate, signed by the grower, stating the number, kinds, packing, and marking of the plants, or portions of plants, and the name and address of the consignee, and certifying that the plants or portions of plants are wholly the produce of the nursery of which he is the occupier, and are, to the best of his knowledge and belief, clean and free from disease; also by a certificate, signed by an officer of the Board of Agriculture and Fisheries, that the nursery in which the plants, or portions of plants, are certified to have been grown has been officially inspected and is clean and free from disease, or

(2) A certificate, signed by an officer of the Board of Agriculture and Fisheries, or by the director of any public or botanic gardens, that the plants, or portions of plants, have been subjected to one of the three following methods of treatment appropriate to the case, viz., that they have been subjected in a suitable enclosure to the fumes of hydrocyanic acid gas for the space of 1 hour, or have been sprayed with or dipped in Bordeaux mixture, or have been sprayed with or dipped in red-oil emulsion of the proportion of 1 part of red-oil to 12 parts of water, or

(3) A certificate, signed by an officer of the Board of Agriculture and Fisheries, or by the director of any public or botanic gardens, that the plants, or portions of plants, are clean and free from disease.

The following arrangements have been made by the Board for the issue of certificates.

Certificate (1).—Nurseries are examined at intervals through the summer, and a "final" inspection is made early in October. Certificates based on this "final" examination will be issued up to the 31st May in the following year. After that date consignments will be examined at the time of despatch until the 30th September.

The fees charged in respect of this service vary according to the size of the nursery examined, but the minimum rate is two guineas. This payment will cover the issue of all certificates required between the 1st October and the 30th September in the following year.

Certificate (2).—The Board have no facilities which will enable them to arrange for the issue of certificates of fumigation or disinfection.

Certificate (3).—In cases where the magnitude of the export trade is not sufficient to warrant the expenditure of two guineas for an inspection, individual consignments may be forwarded to the Board's Office for examination prior to despatch. The Board, however, do not undertake any responsibility for injury to plants submitted to them for examination, and they should be packed in such a manner that they can be easily taken out for examination. If wooden boxes are used, the lid should be screwed and not nailed down. No charge is made for the examination of consignments packed in one box and weighing under 11 lb., but a fee of 2*s.* 6*d.* is charged for the examination of packages between 11 and 56 lb. in weight, and 5*s.* for packages between 56 lb. and 1 cwt. Consignments exceeding 1 cwt. cannot be examined at the Board's offices, and a special fee will be charged in such cases.

Importation of Cattle into Australia.—The Government of the Commonwealth of Australia have reduced the period of quarantine to fourteen days in the case of animals which, immediately prior to shipment from the United Kingdom, have passed the tuberculin test at the Cattle Testing Station at Pirbright, Surrey, and are accompanied by tuberculin certificates i sued by the Board of Agriculture and Fisheries. Such animals are exempt from the tuberculin test on arrival in Australia.

Importation of Forage into Jersey.—The Jersey Authorities now permit the importation of forage from Great Britain, except from the counties of Somerset, Wilts, Gloucester, and Pembroke, on production of the following documents at the port of landing :—

(*a*) A certificate from the Board of Agriculture and Fisheries testifying that no case of cattle-plague or foot-and-mouth disease has occurred during the previous six months on the farm or land on which the forage has been g own, or within a distance of fifteen miles thereof; and

(*b*) A declaration by the exporter, sworn before a Magistrate or Commissioner of Oaths, giving the exact place of origin of the forage.

Intending exporters should apply to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W., for forms of application for official certificates.

Notes on Crop Prospects and Live Stock Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for December, 1915, issued by the International Institute of Agriculture, contains estimates of the production of cereal crops in the Northern Hemisphere. The countries for which it is possible to give approximate estimates are as follows:—In *Europe*—Hungary (proper), Denmark, Spain, France, Great Britain, Ireland, Italy, Luxemburg, Norway, Netherlands, Rumania, Russia in Europe (54 Governments), Switzerland; in *America*—Canada, United States; in *Asia*—India, Japan, Russia in Asia (10 Governments in 1915 and 9 Governmeuts in 1914); in *Africa*—Egypt, Tunis.

Wheat.—The total production in the above-mentioned countries is estimated to amount to 448,681,000 qr. in 1915, against 375,875,000 qr. in 1914, the increase being equal to 19·4 per cent., while the area sown was greater by 7 per cent.

Rye.—In the afore-mentioned countries, excluding Great Britain, India, Japan, Egypt, and Tunis, the total production is placed at 137,101,000 qr., or an increase of 14·8 per cent. compared with last year, when the production amounted to 119,395,000 qr. The area under cultivation was smaller by 0·3 per cent.

Barley.—The total production in the above countries, exclusive of India, is estimated to approximate to 146,370,000 qr. this year, against 125,102,000 qr. last year, or an increase of 17 per cent., but the area showed a decrease of 1·2 per cent.

Oats.—For the specified countries, excluding India, Japan, and Egypt, the production is estimated at 397,077,000 qr. in 1915, against 321,416,000 qr. in 1914, the increase being equal to 23·5 per cent. while the area sown was 1·3 per cent. greater.

Maize.—In Hungary, Italy, Rumania, Russia in Europe (54 Governments), Switzerland, Canada, United States, Japan, and Russia in Asia (10 Governments in 1915 and 9 Governments in 1914), the total production is estimated at 417,683,000 qr. this year, against 368,397,000 qr. last year, or an increase of 13·4 per cent., the area uuder cultivation being greater by 5·8 per cent.

In the Southern Hemisphere the production of wheat in New Zealand is estimated at 830,000 qr. in 1914-15 against 654,000 qr. in the previous year, or an increase of 27 per cent., while the area sown was larger by 37·7 per cent.

Russia.—According to data collected by the Ministry of the Interior and the Central Statistical Committee, the condition of the winter crops in 64 Governments and Districts on 14th November last was as follows: Average in 12 Governments, above average in 6 Governments, considerably above average in 21 Governments, nearly good in 18 Governments, and good in 7 Governments. (*The London Grain, Seed and Oil Reporter*, 21st December.)

United States.—The final estimates of the total production of the chief crops, issued on the 15th December by the Bureau of Crop Estimates, are as follows:—Wheat, 1,011,505,000 bush. compared with 891,017,000 bush. in 1914; barley, 237,009,000 bush. against 194,953,000 bush.; oats, 1,540,362,000 bush. against 1,141,060,000 bush.; maize, 3,054,535,000 bush. against 2,672,804,000 bush.; and linseed, 13,845,000 bush. against 13,749,000 bush. last year.

The Statistician of the United States Department of Agriculture, in a report issued 17th December, estimates the condititition of the growing winter wheat crop on the 1st December at 87·8 as compared with 88·3 in December last year, whilst the estimated area sown with winter wheat is 37,256,000 acres against 42,012,000 acres, the revised estimate last year. The condition of the rye crop is estimated at 91·5, against 93·6 a year ago, whilst the areage of this crop is 3,058,000 acres compared with 2,851,000 acres last year. (*Broomhall's Corn Trade News*, 17th December.)

Argentina.—Reports from practically all quarters of the grain area continue to be highly satisfactory. Rain fell during the last week in November over a considerable section of the northern zone of the Central Argentine Railway, and also over a large area of the Buenos Aires Western Railway zone. Harvesting of oats has commenced in several districts of the Province of Buenos Aires, yield and quality being reported satisfactory. Wheat and linseed were being cut at the beginning of December in some of the western districts of Entre Rios, and wheat and oats in the Gualeguaychú district of the same province. (*The Review of the River Plate*, 3rd December.)

The harvesting of oats and linseed was practically general in the second week of December, and that of wheat was partial and would become general in the following two or three weeks. The weather had favoured rapid ripening, and the conditions and prospects for the yield were generally satisfactory at the date of the report, being very good in some instances. (*The Review of the River Plate*, 10th December.)

India.—The first Government forecast of the area sown with wheat in 1915-16 gives the following totals for the four districts, the Punjab, United Provinces, North-west Frontier and Bengal: Wheat, 17,968,000 acres as compared with 19,808,000 acres, the final estimate for 1914-1915; linseed, 530,000 acres against 503,000 acres; and rapeseed 2,325,000 acres against 2,662,000 acres last season. In the Punjab, germination has been good, while crop prospects are fair in Bengal and good in the United Provinces. (*The London Grain, Seed and Oil Reporter*, 23rd December.)

Live Stock in France.—The numbers of farm stock on the 1st July, 1915, are as follows (the corresponding numbers on the 31st December, 1914, being shown in brackets): Horses, 2,227,209 (2,205,192); cattle, 12,286,849 (12,668,243); sheep, 13,483,189 (14,038,361); pigs, 5,490,796 (5,926,291).

Agricultural Conditions in England and Wales on 1st January.

THE Crop Reporters of the Board, in reporting on the crops and agricultural conditions on the 1st January, state that the wet and often stormy weather very largely prevented work in the fields during December. The early-sown wheat, although backward, is generally a good plant, but late sowings have been very slow in germinating, and where they are up they are not so satisfactory as the early sown, more especially on wet lands. As very little could be done during the month, the acreage now under wheat is only about three-fourths of the area intended for this crop; and, as compared with the end of 1914 (when probably over 80 per cent. had been got in), the acreage actually sown is about 6 or 7 per cent. less. Winter oats and beans, although also backward, are generally satisfactory.

Seeds are very generally a healthy and promising crop; here and there they have suffered a little from the wet.

Turnips and swedes, although small, are generally of good quality, but some damage has been done by frosts in the northern districts, Shortage of labour has interfered with pulling in many parts, and more will probably be fed off than nsual.

The weather has been very trying for outlying stock, especially sheep on turnips; but they have stood the conditions satisfactorily on the whole. Ewes are healthy, but cannot be reported as having done more than fairly well during the month; they have done best where well supplied with dry food. Dorset Horn lambs appear to be strong and fairly plentiful.

Agricultural Labour in England and Wales during December.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st January, the shortage of labour was not badly felt, as a rule, during December, with little work possible during the month; but there was everywhere scarcity and wages were high.

The following local summaries give further details regarding agricultural labour in the different districts:—

Northumberland, Durham, Cumberland and Westmorland.—With little work possible during December, the shortage in the supply of labour was not much felt during the month, except in the case of casual labour for threshing.

Lancashire and Cheshire.—Labour was everywhere scarce and wages were rising. The deficiency was expected to be felt still more when the weather mends.

Yorkshire.—There was general complaint as to the scarcity of farm workers, and wages were very high.

Shropshire and Stafford.—Labour was still very scarce and wages were rising.

Derby, Nottingham, Leicester and Rutland.—In all parts of the division there was a very short supply of labour.

Lincoln and Norfolk.—The scarcity in the supply of labonr did not appear to have been seriously felt during December in most districts, more particularly in Lincolnshire.

Suffolk, Cambridge and Huntingdon.—Skilled labour was still short in most districts and wages were high. Many women were being employed in north Cambridgeshire.

Bedford, Northampton and Warwick.—There was a scarcity of farm workers throughout the division, the supply in some districts being very deficient, and casual labour was very difficult to obtain.

Buckingham, Oxford and Berkshire.—Labour continued to be very short generally.

Worcester, Hereford and Gloucester.—The supply of labour continued to be very short, and the position, generally, appeared to be becoming more unfavourable.

Cornwall, Devon and Somerset.—The supply of labour was deficient, and farmers were working under great difficulties on this account.

Dorset, Wiltshire and Hampshire.—Labour was still deficient and was missed on dairy farms, and other work was neglected as a consequence. The shortage will probably be felt more as the weather improves.

Surrey, Kent and Sussex.—The supply was still very short, and it will probably be more seriously felt as the spring approaches.

Essex, Hertford and Middlesex.—The supply of labour was getting increasingly short, and it was anticipated that the scarcity of workers will be keenly felt as the season advances.

North Wales.—The position varied considerably, even in the same county some districts having enough hands for the present, whilst others were very short.

Mid Wales.—Excepting in south-west Cardigan, where the supply was ample for present requirements, there was a general shortage of labour, and the outlook for the spring was regarded with serious misgiving.

South Wales.—There was decided shortage in the supply of labour, and most of the men were needed to attend to the stock. Casual workers were difficult to obtain.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st January, 1916, certain diseases of animals existed in the countries specified :—

Austria (on the 24th Nov.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (month of Nov.).
Anthrax, Foot-and-Mouth Disease (268 outbreaks), Swine Erysipelas, Swine Fever.

France (for the period 5th—18th Dec.).
Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Germany (for the period 15th—30th Nov.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (month of Nov.).
Anthrax, Foot-and-Mouth Disease (233 outbreaks), Foot-rot, Swine Erysipelas.

Hungary (on the 24th Nov.).
Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox, Swine Erysipelas, Swine Fever.

Italy (for the period 13th—19th Dec.).
Anthrax, Blackleg, Foot-and-Mouth Disease (1,985 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosis.

Norway (month of Nov.).
Anthrax, Swine Fever.

Rumania (for the period 14th—21st Nov.).
Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Swine Fever,

Russia (month of Aug.).
Anthrax, Foot-and-Mouth Disease (324,017 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (month of Sept.).
Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (month of Nov.).
Anthrax, Blackleg, Foot-and-Mouth Disease (2 outbreaks), Swine Fever.

Switzerland (for the period 6th—12th Dec.).

Anthrax, Blackleg, Foot-and-Mouth Disease (17 "étables" entailing 297 animals, of which 7 "étables" were declared infected during the period), Swine Fever.

No further returns have been received in respect of the following countries :—Belgium, Bulgaria, Montenegro, Serbia.

The Weather in England during December.

District.	Temperature.		Rainfall.				Bright Sunshine.	
	Daily Mean.	Diff. from Average.	Amount.		Diff. from Average.	No. of Days with Rain.	Daily Mean.	Diff. from Average.
Week ending Dec. 4th:	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours.
England, N.E. ...	36·7	−4·4	1·48	38	+26	5	1·1	−0·4
England, E.	40·8	+0·1	1·03	26	+13	6	1·0	−0·6
Midland Counties ...	37·9	−2·5	1·44	37	+24	6	0·7	−0·7
England, S.E.... ...	42·9	+0·5	2·01	51	+35	6	0·4	−1·2
England, N.W. ...	37·9	−4·4	1·17	30	+ 8	5	0·8	−0·5
England, S.W. ...	43·6	−0·1	2·15	55	+30	6	0·5	−1·3
English Channel ...	47·8	+0·5	2·18	55	+32	7	1·1	−0·8
Week ending Dec. 11th:								
England, N.E.... ...	40·8	+0·7	1·43	36	+22	6	1·3	0·0
England, E.	44·8	+5·0	1·18	30	+16	6	1·2	−0·2
Midland Counties ...	42·9	+3·3	1·41	36	+21	6	1·3	0·0
England, S.E.... ...	46·9	+5·2	2·02	52	+34	6	1·4	−0·1
England, N.W. ...	41·7	+0·2	1·96	50	+27	6	0·9	−0·2
England, S.W. ...	46·8	+3·7	2·26	57	+28	7	1·0	−0·6
English Channel ...	50·4	+3·6	2·94	75	+48	7	1·1	−0·8
Week ending Dec. 18th:								
England, N.E. ...	37·5	−1·7	0·41	10	− 5	5	2·0	+0·8
England, E.	38·7	−0·3	0·67	17	+ 5	4	1·1	−0·4
Midland Counties ...	37·0	−1·8	0·55	14	0	4	1·2	+0·1
England, S.E.... ...	39·3	−1·8	1·02	26	+11	4	1·3	−0·1
England, N.W. ...	38·8	−1·8	0·59	15	− 5	4	1·4	+0·4
England, S.W. ...	40·1	−2·5	1·43	36	+ 9	5	1·9	+0·4
English Channel ...	43·9	−2·3	1·36	35	+11	6	2·1	+0·3
Week ending Dec. 25th:								
England, N.E. ...	40·1	+1·6	1·01	26	+14	6	0·7	−0·4
England, E.	41·1	+3·0	1·04	26	+17	6	0·9	−0·5
Midland Counties ...	41·0	+3·0	1·00	26	+14	6	0·5	−0·6
England, S.E.... ...	42·9	+2·7	1·49	38	+26	6	1·1	−0·4
England, N.W. ...	41·3	+1·6	1·57	40	+23	6	0·6	−0·4
England, S.W. ...	43·3	+1·4	1·97	50	+27	6	1·0	−0·4
English Channel ...	47·4	+1·9	1·20	31	+12	5	1·2	−0·6
Week ending Jan. 1st:								
England, N.E. ..	43·8	+5·8	1·13	29	+19	6	0·5	−0·6
England, E.	46·0	+8·5	0·55	14	+ 4	5	1·1	−0·2
Midland Counties ...	45·8	+8·4	1·19	30	+17	6	0·9	−0·2
England, S.E.... ...	48·2	+8·6	1·19	30	+17	5	4·9	−0·5
England, N.W. ...	44·7	+5·4	1·65	42	+25	7	0·7	−0·2
England, S.W. ...	48·2	+6·8	1·83	47	+23	6	0·5	−0·8
English Channel ...	50·2	+5·2	1·15	29	+ 9	5	1·4	−0·5

* 1 inch = 25·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

Disease.	December.		Twelve Months ended December.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	47	58	575	722
Animals attacked	46	71	641	796
Foot-and-Mouth Disease:—				
Outbreaks	7	3	56	27
Animals attacked	22	42	693	166
Glanders (including Farcy):—				
Outbreaks	3	6	50	97
Animals attacked	5	11	87	286
Parasitic Mange:—				
Outbreaks	141	†—	*911	†1,530
Animals attacked	295	†—	*1,951	†2,642
Sheep-Scab:—				
Outbreaks	69	38	257	226
Swine Fever:—				
Outbreaks	280	300	3,994	4,356
Swine Slaughtered as diseased or exposed to infection ...	814	1,509	16,702	39,277

* Figures for nine months only. † The Parasitic Mange Order of 1911 was suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

Disease.	December.		Twelve Months ended December.	
	1915.	1914.	1915.	1914.
Anthrax:—				
Outbreaks	—	—	2	1
Animals attacked	—	—	2	1
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	76
Animals attacked	—	—	—	957
Glanders (including Farcy):—				
Outbreaks	—	—	1	—
Animals attacked	—	—	3	—
Parasitic Mange:—				
Outbreaks	4	2	72	76
Sheep-Scab:—				
Outbreaks	34	30	412	484
Swine Fever:—				
Outbreaks	11	8	247	193
Swine Slaughtered as diseased or exposed to infection ...	51	48	1,361	967

Unit Prices of Artificial Manures.

Statement of cost to the purchaser of 1 per cent. per ton of Nitrogen, Soluble and Insoluble Phosphates, and Potash derived from

	London.	King's Lynn.	Hull.	Newcastle.
	s. d.	s. d.	s. d.	s. d.
Nitrogen from :				
Sulphate of Ammonia pure ... 95%	—	—	17 0	17 0
Sulphate of Ammonia pure ... 93%	—	—	16 11½	—
Calcium Cyanamide ...	—	—	14 0½	14 2½
Nitrate of Soda pure 95%	—	—	20 4	—
Nitrate of Soda pure 90%	20 6	—	20 4	21 4
Nitrate of Lime ...	—	—	14 6	—
Soluble Phosphates from :				
Superphosphate 35%	2 8½	—	2 8	2 10½
,, 33%	2 8½	2 4	2 9	2 10
,, 30%	2 9½	—	2 10½	2 11½
,, 26%	3 0½	2 8½	3 1	3 3
Dissolved Bones	3 9	—	3 6	5 1½
Allowed for Nitrogen	*21 1*	—	*19 9½*	*28 9½*
Allowed for Insol. Phos.	*2 2½*	—	*2 1*	*3 0½*
Insoluble Phosphates (Citric Soluble) from :				
Basic Slag	2 5½	—	1 11½	—
Insoluble Phosphates from :				
Basic Slag	—	—	1 11	1 7½
Bone Meal	1 10½	—	1 9	1 9½
Allowed for Nitrogen	*17 10*	—	*16 9*	*16 10*
Steamed Bone Flour ...	1 10½	—	1 11½	2 0
Allowed for Nitrogen	*17 8*	—	*18 7½*	*19 1*
Potash from :				
Kainit	—	—	—	—
Sulphate of Potash ...	—	—	—	—
Muriate of Potash ...	—	—	—	—
Potash Salts	—	—	—	—

NOTE.—These unit prices are based on the *probable* retail cash prices in bags f.o.r. for quantities of not less than 2 tons of the manures mentioned at the ports and places specified, but it should be borne in mind that market prices are fluctuating considerably at the present time. The prices are published by the Board of Agriculture and Fisheries for use in comparing the commercial values of artificial manures. They may also be used as a guide to the probable price per ton of any of the manures mentioned if the unit prices of the constituents of the

various sources, at certain ports and Manufacturing Centres, for January, 1916.

Silloth.	Liverpool.	Widnes.	Newport.	Bristol.	Plymouth.
s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
—	—	—	17 0	—	—
—	17 11	17 11½	—	17 1	—
—	15 0	—	—	—	—
—	19 1	19 6	—	20 4	19 2½
—	—	—	20 4	—	19 10
—	—	—	—	—	—
—	2 8½	2 8	2 9½	2 9½	2 9½
—	2 9½	2 8½	2 9½	2 9½	2 9¼
—	2 10½	2 9½	2 10½	2 10½	2 10½
—	3 2	3 1	3 2	3 2	3 2
—	4 1	3 11½	3 10	3 11	3 10
—	23 0¼	22 3½	21 8	22 0	21 6
—	2 5½	2 4	2 3½	2 4	2 3
—	—	—	—	2 1½	—
—	1 11	—	—	—	—
—	1 10	1 10	1 8	1 9½	1 10¼
—	17 6	17 7	15 11½	16 8½	17 9½
—	—	—	1 8	1 11½	—
—	—	—	15 9½	18 6½	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—

manure are multiplied by the percentages of the constituents found in it, and due allowance is made for the difference between cash prices and credit prices, and for cost of carriage from the nearest centre to the place where it is delivered to the purchaser. If used in connection with the valuation of a compound manure regard must be had to the sources of the constituents, and a reasonable sum must be added for mixing, disintegrating and rebagging the ingredients, bags, and loss of weight.

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in December and November, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	December.		November.	
	First Quality.	Second Quality.	First Quality.	Second Quality.
FAT STOCK :—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle :—	s. d.	s. d.	s. d.	s. d.
Polled Scots	11 4	10 10	10 11	10 10
Herefords	11 1	10 1	11 3	10 1
Shorthorns	11 0	9 11	11 3	10 2
Devons	11 2	9 11	11 5	10 3
Welsh Runts	10 8	9 11	10 10	10 2
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	9¾	8½	10	8¼
Sheep :—				
Downs	11	10	10¾	9½
Longwools	10¼	9¼	10	9
Cheviots	11	10	11	10¼
Blackfaced	10¾	9½	10¾	9¼
Welsh	10	9	10	8½
Cross-breds	10¾	9¾	10½	9½
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs :—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	10 6	9 10	10 6	9 10
Porkers	11 4	10 8	11 3	10 8
LEAN STOCK :—	per head.	per head.	per head.	per head.
Milking Cows :—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	29 19	24 10	28 18	23 19
,, —Calvers ...	28 7	23 6	28 0	22 19
Other Breeds—In Milk ...	29 2	23 18	26 9	21 7
,, —Calvers ...	—	20 0	21 0	19 10
Calves for Rearing	2 15	2 2	2 18	2 5
Store Cattle :—				
Shorthorns—Yearlings ...	12 7	10 7	12 19	10 19
,, —Two-year-olds...	16 14	15 3	17 15	15 11
,, —Three-year-olds	23 0	19 5	23 4	19 8
Herefords —Two-year-olds...	19 1	15 14	18 19	16 16
Devons— ,,	17 17	16 7	17 16	15 12
Welsh Runts— ,,	16 15	15 14	18 10	16 10
Store Sheep :—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	49 8	42 11	47 4	41 10
Store Pigs :—				
8 to 12 weeks old	24 2	18 2	26 2	19 8
12 to 16 weeks old	43 10	33 4	46 5	35 4

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in December, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham.	Leeds.	Liverpool.	London.	Manchester.
		per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.
BEEF:—						
English ...	1st	71 6	72 0	—	73 6	70 0
	2nd	67 6	69 6	—	68 6	66 6
Cow and Bull ...	1st	64 6	66 6	61 6	63 0	62 0
	2nd	59 6	60 0	54 6	58 6	57 6
Irish: Port Killed ...	1st	65 6	69 0	71 0	71 0	67 6
	2nd	60 6	65 6	66 0	66 0	63 6
Argentine Frozen—						
Hind Quarters ...	1st	66 6	—	—	—	—
Fore ,, ...	1st	56 0	—	—	—	—
Argentine Chilled—						
Hind Quarters ...	1st	73 6	71 0	72 0	73 0	72 0
Fore ,, ...	1st	57 0	56 6	59 0	55 0	59 0
Australian Frozen—						
Hind Quarters ...	1st	59 0	—	62 0	—	62 0
Fore ,, ...	1st	52 0	—	53 0	—	53 0
VEAL:—						
British ...	1st	84 0	—	—	94 6	—
	2nd	79 6	—	—	85 0	—
Foreign...	1st	—	—	—	95 0	—
MUTTON:—						
Scotch ...	1st	88 6	—	92 6	89 6	93 6
	2nd	86 0	—	87 6	84 6	91 0
English...	1st	89 0	88 6	—	84 6	89 0
	2nd	86 6	84 0	—	80 0	85 0
Irish: Port Killed ...	1st	87 6	—	85 0	83 0	85 0
	2nd	84 6	—	78 6	78 6	82 0
Argentine Frozen ...	1st	63 0	63 6	63 0	65 0	63 0
Australian ,, ...	1st	58 6	58 6	59 6	60 0	60 6
New Zealand ,, ...	1st	59 6	64 0	—	68 6	—
LAMB:—						
British ...	1st	—	—	—	—	—
	2nd	—	—	—	—	—
New Zealand ...	1st	73 6	71 0	72 6	73 0	72 6
Australian ...	1st	66 6	—	66 6	66 6	66 6
Argentine ...	1st	66 0	—	66 6	67 6	66 6
PORK:—						
British ...	1st	103 0	96 0	98 0	99 0	97 6
	2nd	96 0	90 6	89 6	90 0	92 0
Frozen ...	1st	75 0	74 6	78 6	74 6	76 0

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in December, 1915.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	BRISTOL.		LIVERPOOL.		LONDON.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER:—	per 12 lb	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb
British	19 0	17 0	—	—	19 0	18 0
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	164 0	159 6	166 0	163 0	165 6	159 6
„ Factory	137 0	129 6	138 0	129 0	140 0	132 0
Danish	—	—	179 6	177 0	177 0	172 6
French	—	—	—	—	160 0	152 0
Russian	133 6	125 6	—	129 0	137 0	129 0
Canadian	160 6	152 6	157 6	153 6	—	—
Australian	—	—	156 6	153 6	161 0	156 6
New Zealand	167 0	164 0	166 0	162 6	164 6	160 0
Argentine	—	—	161 0	158 6	159 6	155 6
CHEESE:—						
British—						
Cheddar	99 6	93 6	97 0	95 6	100 0	94 0
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	109 0	106 6	114 6	106 0
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	93 0	90 0	94 0	91 0	94 0	91 0
BACON:—						
Irish (Green)	105 0	100 6	102 6	97 0	104 0	98 6
Canadian (Green sides)	93 0	89 0	93 0	90 0	94 0	90 0
HAMS:—						
York (Dried or Smoked)	149 6	142 0	—	—	150 0	140 0
Irish (Dried or Smoked)	—	—	—	—	144 0	138 0
American (Green) (long cut)	100 6	98 6	99 0	96 0	100 0	96 0
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120	per 120.
British	—	—	—	—	28 9	27 1
Irish	25 7	—	24 7	22 10	24 5	22 10
Danish	—	—	—	—	28 2	25 7
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton
British Queen ...	100 0	85 0	—	—	109 0	100 0
Edward VII.	107 0	96 0	85 0	81 6	107 6	98 6
Up-to-date	98 0	90 0	80 0	75 0	104 6	95 6
HAY:—						
Clover	—	—	171 0	130 0	133 6	124 6
Meadow	—	—	—	—	129 6	121 6

CORN PRICES :—ANNUAL AVERAGES.

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Weekly Averages of Corn Returns from the Returning Markets, together with the QUANTITIES returned as sold at such Markets during each of the Years 1909 to 1915.

YEARS.	PRICES.			QUANTITIES.		
	Wheat.	Barley.	Oats.	Wheat.	Barley.	Oats.
	s. d.	s. d.	s. d.	Quarters.	Quarters.	Quarters.
1909..	36 11	26 10	18 11	2,641,225	2,699,628	905,983
1910..	31 8	23 1	17 4	3,072,523	3,205,203	791,121
1911..	31 8	27 3	18 10	3,140,257	3,123,986	858,341
1912..	34 9	30 8	21 6	2,365,596	2,165,572	630,755
1913..	31 8	27 3	19 1	2,511,297	2,948,930	639,298
1914..	34 11	27 2	20 11	3,027,976	3,403,072	1,164,361
1915..	52 10	37 4	30 2	3,225,198	2,552,128	1,181,480

AVERAGE VALUE per IMPERIAL QUARTER OF WHEAT IMPORTED into the UNITED KINGDOM from the undermentioned Foreign Countries and British Possessions in the Years 1913, 1914, and 1915.

Countries from which consigned.	Average Value per Imperial Quarter.		
	1913.	1914.	1915.
	s. d.	s. d.	s. d.
Argentine Republic ..	35 8	34 1	60 8
Chile	36 7	35 7	—
Germany	31 0	32 0	—
Persia	36 11	—	—
Rumania	33 3	33 8	—
Russia	33 11	33 6	50 0
Turkey	23 6	22 5	—
U.S. of America	35 1	37 3	54 7
Australia	37 6	36 6	45 3
British East Indies.. ..	36 6	39 5	54 4
Canada	34 8	37 5	54 10
New Zealand	35 5	37 7	—

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1913, 1914 and 1915.

Weeks ended (*in* 1915).	Wheat.						Barley.						Oats.					
	* 1913.		1914.		1915.		1913.		1914.		1915.		1913.		1914.		1915.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Jan. 2...	30	5	31	1	44	4	28	6	26	2	29	10	19	10	18	2	26	6
,, 9...	30	3	30	11	46	2	28	4	25	11	29	7	19	2	18	4	26	5
,, 16...	30	5	31	0	48	9	28	6	26	0	30	5	19	4	18	6	27	6
,, 23...	30	11	30	11	51	6	28	10	26	3	31	3	19	4	18	11	28	10
,, 30...	31	1	31	1	52	8	28	11	26	6	32	5	20	2	19	1	29	10
Feb. 6...	31	0	31	0	53	3	28	10	26	7	33	7	20	1	18	9	30	3
,, 13...	30	9	31	0	54	8	29	1	26	7	34	7	20	2	18	11	31	1
,, 20...	30	11	31	0	56	0	28	8	26	7	34	11	20	7	18	11	31	5
,, 27...	31	0	31	0	56	0	28	6	26	6	35	3	20	4	18	11	31	8
Mar. 6...	31	3	31	5	55	11	28	5	26	2	34	6	20	0	18	9	31	8
,, 13...	31	1	31	6	54	8	27	11	26	0	33	5	20	2	18	7	31	0
,, 20...	31	1	31	5	53	9	28	6	25	8	32	2	19	11	18	6	30	7
,, 27...	31	3	31	4	54	3	27	6	25	7	31	11	19	7	18	8	30	6
Apl. 3...	31	4	31	6	54	6	27	0	25	6	31	9	19	2	18	5	30	6
,, 10...	31	3	31	5	54	9	27	8	26	8	31	3	19	2	18	4	30	4
,, 17...	31	6	31	7	55	4	26	11	25	4	30	10	18	10	18	4	30	5
,, 24...	31	8	31	9	56	5	26	7	26	6	31	5	19	3	18	5	30	11
May 1...	32	2	31	9	58	3	25	11	26	0	32	7	19	6	18	5	31	5
,, 8...	32	6	32	2	60	5	25	9	25	6	33	3	19	6	18	9	32	4
,, 15...	32	10	32	7	61	7	25	4	26	3	34	0	19	9	18	11	32	5
,, 22...	32	10	33	0	62	0	25	3	25	10	34	1	19	11	19	0	32	8
,, 29...	32	7	33	9	61	11	26	1	26	1	34	8	20	1	19	4	32	7
June 5...	32	10	34	0	61	9	26	2	25	11	35	4	19	8	19	4	32	5
,, 12...	32	8	34	1	60	1	24	7	24	11	34	5	20	2	19	8	32	4
,, 19...	32	8	34	1	56	1	23	10	25	10	34	3	19	8	19	9	31	9
,, 26...	32	8	34	3	52	0	24	3	25	4	34	4	19	1	20	0	31	9
July 3...	33	1	34	4	49	5	25	2	24	6	35	3	21	0	19	9	31	1
,, 10...	33	4	34	2	50	1	25	10	24	9	34	7	19	4	20	0	31	6
,, 17...	33	6	34	1	52	7	24	9	24	2	35	8	20	5	19	10	31	6
,, 24...	33	10	34	0	53	10	24	1	24	7	35	10	20	8	19	9	32	1
,, 31...	34	1	34	2	55	3	24	5	25	9	36	1	20	3	19	8	31	1
Aug. 7...	34	1	34	9	55	4	24	9	25	2	35	7	19	0	19	1	31	5
,, 14...	34	3	40	3	55	2	24	7	29	4	37	0	18	7	25	1	31	7
,, 21...	33	7	38	9	54	3	26	5	29	10	39	4	18	8	24	3	31	4
,, 28...	32	7	36	2	51	11	29	0	30	3	38	3	17	10	23	5	30	0
Sept. 4...	31	11	36	5	45	3	30	11	30	6	38	1	17	8	23	9	26	10
,, 11...	31	9	37	10	43	0	31	5	29	11	37	11	18	0	23	11	26	8
,, 18...	31	7	38	3	42	9	30	9	29	5	39	0	17	11	23	8	26	4
,, 25...	31	6	37	6	43	3	30	1	29	3	39	8	17	9	23	3	26	1
Oct. 2...	31	3	37	1	43	5	29	9	29	1	40	4	17	10	22	9	26	5
,, 9...	31	0	36	8	44	1	29	1	28	10	41	0	17	10	22	5	26	5
,, 16...	30	11	36	7	45	9	28	8	28	8	42	3	17	9	22	4	27	1
,, 23...	30	7	37	2	48	2	28	7	28	7	44	0	18	0	22	5	28	1
,, 30...	30	1	37	10	50	3	28	2	28	3	46	2	17	9	23	7	29	1
Nov. 6...	30	0	38	8	51	6	28	1	28	6	47	3	17	9	23	7	30	4
,, 13...	30	1	39	8	52	8	27	8	29	0	47	5	17	11	24	8	30	11
,, 20...	30	4	41	0	53	6	27	5	29	8	47	11	18	1	25	5	31	3
,, 27...	30	9	41	11	54	2	27	0	30	3	48	7	18	4	25	8	31	1
Dec. 4...	31	2	42	2	53	7	26	8	30	2	48	11	18	4	25	9	30	11
,, 11...	31	2	42	1	52	10	26	5	29	11	47	10	18	6	25	9	30	4
,, 18...	31	2	42	7	53	11	25	11	29	8	47	5	18	5	25	9	30	6
,, 25...	31	0	43	3	53	10	25	10	29	9	47	2	18	4	25	11	30	7
Jan. 1, 1916	31	1	44	4	54	9	26	2	29	10	47	5	18	2	26	6	30	10

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of December, 1914 and 1915.

—	Wheat.		Barley.		Oats.	
	1914.	1915.	1914.	1915.	1914.	1915.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
London	44 1	55 1	31 3	45 11	27 1	32 6
Norwich	41 11	52 11	29 6	47 0	26 0	30 8
Peterborough	42 5	53 2	29 5	47 5	25 8	31 1
Lincoln	43 0	53 10	29 8	47 1	25 5	30 8
Doncaster	42 8	53 10	28 7	46 9	25 0	30 2
Salisbury	42 3	53 0	30 5	48 9	26 7	31 1

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous—

Agriculture in Italy. (Estate Mag., July, 1915.) [63(45).]

Potash—Its Distribution, Commercial Sources and Agricultural Value. *A. Smetham*. (Jour. Roy. Lancs. Agric. Soc., 1915.) [63.1673.]

Seaweed as a Source of Potash for Agriculture. *A. A. Moffatt*. (Trans. Highland and Agric. Socy., 5th Series, Vol. XXVII., 1915.) [63.165.]

Agriculture in Turkey. (Estate Mag., Aug., 1915). [63(4).]

The Preparation of Fertilizer from Municipal Waste, *J. W. Turrentine*. (Yearbook, U.S. Dept. Agric., 1914.) [628.2.]

Plant Breeding in Canada, *W. T. Macoun*. (Jour. Heredity, Sept., 1915.) [575.4.]

On the Influence of Planting-Distance on the Yield of Crops, *F. J. Chittenden*. [63.19.] Note on Further Trials of Explosives in the Garden, *H. E. Durham*. [63.196.] (Jour. Roy. Hort. Soc., Vol. XLI., Pt. 1, Aug., 1915.)

The Effect of Climate on Soil Formation, *J. W. Leather*. [63.11(04).] On the Probable Error of Sampling in Soil Surveys, *G. W. Robinson* and *W. E. Lloyd*. [63.113.] The Effect of Removing Soluble Humus from a Soil on its Productiveness, *W. Weir*. [63.11(04).] (Jour. Agric. Sci., Vol. VII., Pt. 2, Sept., 1915.)

Agriculture in Portugal. (Estate Mag., Sept., 1915.) [63(469).]

The Field and Forest Resources of British Guiana, *J. B. Harrison* and *C. K. Bancroft*. [63(6).] The Economic Resources of the German Colonies. II. German South-West Africa. [63(68).] (Bull. Imperial Inst., Apl.-June, 1915.)

Field Crops—

The Sugar Beet in Germany, with special Attention to its Relation to Climate, *E. van Cleef*. (Bull. Amer. Geograph. Soc., April and May, 1915.) [63.3432].

Wild White Clover, *A. N. M'Alpine*. (Trans. Highland and Agric. Socy., 5th Series, Vol. XXVII., 1915.) [63.33(6).]

The Effect of Manganese Sulphate on the Yield of Turnips at Wisley, *F. J. Chittenden*. (Jour. Roy. Hort. Soc., Vol. XLI., Pt. 1, August, 1915.) [63.167.]

Variation in the Male Hop, *Humulus lupulus*, L., *H. Wormald*. [63.3451.] The Influence on Crop and Soil of Manures applied to Permanent Meadow, *C. Crowther* and *A. G. Ruston*. [63.33-16.] (Jour. Agric. Sci., Vol. VII., Pt. 2, September, 1915.)

An Improved Fibre Plant (*Hibiscus cannabinus*), *A. Howard* and *G. L. C. Howard*. (Agric. Jour. India, July, 1915.) [63.341.]

Horticulture—

On Keeping Orchards Clean, *H. M. Lefroy*. [63.24–41.] Growth of Apple Trees Pruned and not Pruned in the Season of Planting, *F. J. Chittenden*. [63.41(*a*).] A Note on Storing Apples, *G. O. Nicholson* [63.41(*a*).] (Jour. Roy. Hort. Soc., Vol. XLI., Pt. 1, August, 1915.)

Plant Diseases—

Kerosene Traps as a means of Checking up the Effectiveness of a Poisoned Bait Spray to Control the Mediterranean Fruit Fly (*Ceratitis capitata*, Wied), with a Record of Beneficial Insects captured in the Kerosene. *H. H. P. Severin*. (Jour. Econ. Ent., June, 1915.) [63.29.]

Smelter Fumes Injury to Vegetation, *G. P. Weldon*. (Mo. Bull. Calif. St. Comm. Hortic., Vol. IV., Nos. 5 & 6.) [614.7.]

The Control of Peach-Leaf Curl (*Exoascus deformans*), *A. S. Horne*. (Jour. Roy. Hort. Soc., Vol. XLI., Pt. 1, August, 1915.) [63.24.]

The Theory of Wetting, and the Determination of the Wetting Power of Dipping and Spraying Fluids containing a Soap Basis, *W. F. Cooper* and *W. H. Nuttall*. (Jour. Agric. Sci., Vol. VII., Pt. 2, September, 1915.) [63.294.]

"Black Neck" or Wilt Disease of Asters, *W. Robinson*. [63.24–52.] A Contribution to our Knowledge of Silverleaf Disease, *J. Smolak*. [63.24–41.] Note on American Gooseberry Mildew, *M. A. Bailey*. [63.24.] On Diseases of Plum Trees caused by some Species of *Cytospora*, *W. N. C. Belgrave*. [63.24.] (Ann. Appl. Biol., Vol. II., Nos. 2 & 3, July, 1915.)

Live Stock—

The Properties of Wool, *W. Davis*. (Trans. Highland and Agric. Socy., 5th Series, Vol. XXVII., 1915.) [63.761.]

Probable Error in Pig-feeding Trials, *C. Crowther*. [63.64.] The Starch Equivalent Theory, *J. Alan Murray*. [612.394.] The Maintenance Ration of the Ox and the Starch Equivalent Theory, *E. T. Halnan*. [612.394; 63.62.] (Jour. Agric. Sci., Vol. VII., Pt. 2, September, 1915.)

Dairying and Food, General—

A Method for the Estimation of Chlorides in Cheese, *E. C. V. Cornish* and *J. Golding*. (Analyst, May, 1915.) [543.2.]

Prickly-Pears as a Feed for Dairy Cows, *T. E. Woodward* and others. (Jour. Agric. Research, [U.S.A.] Vol. IV., No. 5, Aug., 1915.) [63.711.]

The Composition of Dutch Cheese, and the System of Control for Whole-Milk Dutch Cheese, *J. J. L. van Rijn*. (Analyst, September, 1915.) [63.736.]

Veterinary Science—

Inquiry into Braxy, with a Note on "Grass Sickness" and "Head Grit" in Lambs, and "Bracken Sickness" in Cattle, *J. P. M'Gowan*. (Trans. Highland and Agric. Socy., 5th Series, Vol. XXVII., 1915.) [619.3.]

On Ovariotomy in Sows; with General Observations on the Mammary Glands and the Internal Genital Organs, Part IV., *K. J. J. Mackenzie* and *F. H. A. Marshall*. (Jour. Agric. Sci., Vol. VII., Pt. 2, September, 1915.) [612; 619.4.]

The Effect of Various Chemicals on the Blow-Fly, *W. F. Cooper* and *W. A. B. Walling*. (Ann. Appl. Biol., Vol. II., Nos. 2 & 3, July, 1915.) [59.169(*c*).]

Birds, Poultry, and Bees—

The Value of Birds to Man. (Jour. Roy. Soc. Arts., June 18th, 1915.) [59.162.]

The Food of Birds. Report for the Years 1913–14, *L. Florence*. (Trans. Highland and Agric. Socy, 5th Series, Vol. XXVII, 1915.) [59.162.]

The Egg and Poultry Demonstration Car Work in Reducing our $50,000,000 Waste in Eggs. *M. E. Pennington* and others. (Yearbook, U.S. Dept. Agric., 1914.) [63.74; 63.651(04).]

(4235.) P. 16—9. 7,250. 1/16. J. T. & S., Ltd.

// THE JOURNAL
OF THE
BOARD OF AGRICULTURE
Vol. XXII. No. 11.
FEBRUARY, 1916.

REPORT ON AN INQUIRY INTO THE QUALITY OF FARM SEEDS—1912-1914.

R. H. BIFFEN, M.A., F.R.S.,

Professor of Agricultural Botany, School of Agriculture, Cambridge University.

DURING the years 1912, 1913, and 1914 samples of the commoner kinds of clover and grass seeds offered for sale in various parts of the country were collected by the Board's inspectors, and subsequently examined at Cambridge, on behalf of the Board, in order to determine their purity and germinating capacity. These samples were obtained from all kinds of dealers in seeds, from the large merchants who handle nothing but agricultural seeds down to village tradesmen whose sales of seeds form but a small proportion of their total miscellaneous dealings. In each year a few samples were also obtained directly from farmers interested in the inquiry. The number of samples examined in detail was 676, and in addition partial analyses were made of a small number of samples (49) of mixed grasses and clovers.

In 1912, 208 samples were obtained from all parts of the country, mainly, however, from the Eastern and Southern Counties. In 1913, 295 samples were collected in the Midlands and South-Midland Counties, the West of England and North Wales, and in 1914 the inquiry was limited to the three Ridings of Yorkshire, in which 173 samples were collected.

The total number of samples is perhaps too small to provide more than an approximate survey of the supply available to farmers purchasing their seeds locally, but taking the three years together the averaged results probably reflect the state of affairs throughout the country with sufficient accuracy. Whether this is the case or not, the broad facts emerging from an analysis of the results are obvious and indisputable.

These results show that, though seeds of the highest quality can be purchased, much of the seed offered for sale is of indifferent quality, whilst some of it is excessively bad from all points of view. They also show that when ordering home-grown seed the purchaser cannot count upon receiving it; for foreign seed is frequently substituted for it wholly or in part. Other forms of adulteration, however, are rare. Further, the art of "faking," whereby the natural appearance of the seed is altered, generally to obliterate symptoms associated with age, is not altogether extinct. The evidence for these statements and other facts brought out are given below in a series of notes dealing with each of the kinds of seed examined.

The results of the analyses are summarised in Table I., showing the average "real value" for the more important agricultural seeds in each of the years 1912, 1913, and 1914. The percentage of real value is obtained by multiplying together the percentage of purity and the percentage of seeds capable of germination and dividing the result by 100. For example, if the purity of a sample of red clover is 96 per cent., and its germinating capacity 92 per cent., the real value is $\frac{96 \times 92}{100}$, or 88·3 per cent. The figures for all the samples of any given kind are averaged together. Thus, under the heading of English or Welsh red clover for the year 1912 the real value, calculated from 56 samples, was 67·3 per cent. Or, putting the matter in a more practical way, the figures show that a purchaser of 100 lb. of this average red clover seed would only obtain about 67¼ lb. of *useful seed*, the remainder con-

TABLE I.

Average Real Value per cent.

(The figures in brackets refer to the number of samples examined.)

Seed.	*1912.*	*1913.*	*1914.*
Red Clover	67·3 (56)	58·1 (42)	55·9 (30)
White Clover	50·6 (31)	61·3 (30)	56·9 (45)
Alsike	54·5 (29)	58·1 (21)	62·5 (25)
Cowgrass	..	68·8 (17)	72·7 (24)
Trefoil	..	67·9 (15)	..
Sainfoin	45·8 (10)	35·5 (29)	..
Italian Rye Grass ..	79·2 (37)	72·5 (24)	..
Perennial Rye Grass ..	72·5 (23)	71·8 (23)	..
Cocksfoot..	..	66·0 (16)	63·1 (20)
Meadow Foxtail ..	..	46·9 (15)	51·4 (13)
Timothy	..	92·6 (13)	..
Mangold	116·4 (20)	..	116·7 (22)

sisting of 32¾ lb. of dead seeds, weed seeds and rubbish. Stating the results by averages only, masks the fact that there is a wide range of difference between the good and bad samples. Some idea of the differences is given in Table II., which shows the highest and lowest values of the germinating capacity of each kind of seed dealt with in the course of the inquiry. Further information is given in the notes dealing with the general results of the analyses.

TABLE II.

Highest and Lowest Percentage of Germination.

Seed.	*1912.*	*1913.*	*1914.*
Red Clover	95 — 2	92·3 — 0·3	93·6 — 0
White Clover	91 — 0·6	98·6 — 4·6	93·6 — 2·3
Alsike	80 — 25	98 — 0·6	88 — 1
Cowgrass	..	91·6 — 3	95·6 — 46·2
Trefoil	..	92 — 14	..
Sainfoin	75 — 3	89 — 0	..
Italian Rye Grass ..	97 — 62	91 — 46	..
Perennial Rye Grass ..	94 — 3	91 — 46	..
Cocksfoot	..	90 — 44	92 — 22
Meadow Foxtail ..	..	81·9 — 0	88 — 8
Timothy	..	99 — 90·3	..
Mangold*	191 — 52	..	165 — 49

* Seeds germinating in 100 fruits.

No attempt has been made to compare the percentages of *purity* of the different kinds of seeds, for a mere tabulation of the results in a manner similar to those for the germinating capacity would be misleading. The impurities present in seeds fall into two classes: (1) *harmless impurities*, such as chaff and grit, and (2) *harmful impurities*, such as weed seeds or even seeds of a different kind deliberately added with a view of increasing the vendors' profits. By way of example, the purity of a sample of meadow foxtail may be compared with the purity of a sample of red clover. The value for the purest sample of the former met with during the inquiry was 89·4 per cent., and several samples of red clover had approximately the same percentage of purity. In the case of the foxtail the impurity consisted almost entirely of chaff, which is particularly difficult to separate from the perfect seeds. The only complication to which its presence leads is the small one of making an allowance for it in order to secure the correct amount of pure seed in compounding a mixture for permanent pasture. Sowing such seed leads to no harmful result. In the case of the red clover, however, the same amount of impurity is a serious matter, for the

10·6 per cent. of waste matter consists of weed seeds, of which, for the moment, mention need only be made of docks and clover dodder. In place of a table of the percentages of purity a short account of the impurities most commonly met with, and occasionally an indication of their prevalence, are given in the general notes dealing with each kind of seed examined.

Records of the prices asked for each lot of seed sampled were made throughout the inquiry. With some outstanding exceptions, these records show that the higher-priced lots were superior to those for which lower prices were asked. Nevertheless, some utterly valueless samples were met with for which average prices had been demanded. Where the question of price is of special interest the average value has been determined for the year 1913 for comparison with the prices quoted for the best value then obtainable. In this connection it should be remembered that in 1913 the prices for clover seeds of various kinds were above the usual average owing to the unfavourable conditions obtaining during the growing and harvesting time in 1912, whilst grass seed, much of which is produced abroad, was about the average price of previous years.

Red Clover.—The 128 samples investigated were all purchased under the description of English or Welsh-grown red clover. Nevertheless 33 of them contained the seeds of plants which do not occur in the wild state in this country, but are characteristic weeds of the clover crop in Chile, Canada, France and Russia. Their presence points to the fact that foreign-grown seed had been either wholly substituted for the home-grown, or that stocks of the latter had been eked out by the addition of imported seed. The commonest adulterant was Chilian red clover. This can usually be detected with ease on account of the fact that it generally contains quantities of the seeds of a local clover dodder. These are of approximately the same size as the seeds of the clover itself, and although the majority of them can be removed by the use of suitable cleaning machinery a few generally remain to indicate the country of origin of the seed.

The low average value (67·3, 58·1 and 55·9) of these clover samples was due, in the main, to the fact that many, probably the majority, of the samples consisted of mixtures of seeds of various years' growth. A good clover sample of the current season's growth consists mainly of seeds ranging in colour from shades of lemon-yellow, yellowish-grey and slate colour to purple. It may, particularly if somewhat unripe, contain a few

smaller, partially-shrivelled brown seeds. If such a sample is stored the colours tend to become more uniform, and in a few years' time all of the seeds take on a characteristic foxy-brown colour. If then full-sized brown seeds are present one may suspect that part of the sample, if not all, consists of old seeds. Their presence was characteristic of many of the samples examined, and wherever they were numerous there was a proportionately low germinating capacity when the samples were tested. In one, indeed, which must have been of some respectable antiquity, not a single seed was capable of germinating. On the other hand, several of the freshly-coloured samples reached the passable figure of 95 per cent. for germinating capacity. The difference in the appearance of good and bad samples is so striking that it is difficult to understand why seeds, which obviously will not grow, are ever purchased.

The impurities present on the average amounted to 6 per cent. In the best samples only the merest traces of impurities could be detected, whilst the worst single sample contained 21 per cent. These impurities consisted mainly of weed seeds, fragments of grit, and the debris of clover plants, such as fragments of stems and of clover pods. The commonest weed-seeds present were those of the plantain, campion, geranium, dock, and clover dodder. Those of plants not natives of our own flora are for the time being neglected, as they mostly fail to establish themselves in this country. This fact is worth noting, for it raises the question whether the clover itself, from countries with climatic and soil conditions very unlike those obtaining in Britain, is likely to prove as suitable for British cultivation as the seed of English-grown crops.

In the opinion of the writer the seeds of plantains, campion, and geranium are only serious impurities where the clover is grown for seed. They take the place of clover plants it is true, but even if they seed themselves freely, the resulting plants are easily eradicated in the ordinary course of farming. This, however, is not true in the case of docks, for though the cutting of the crop prevents the formation of mature seeds, a vigorous perennial root is left in the soil. The subsequent ploughing in of the crop does little more than temporarily disturb it, leaving it, unless hand-pulled, to develop a crop of seeds in the following wheat crop. Viewed from a practical standpoint the presence of only 1 per cent. of dock seed in an otherwise pure sample of clover should be sufficient to condemn it. It means that in every pound of red clover seed purchased there are some 3,200

dock seeds,* and if the clover is sown at the rate of 16 lb. per acre no fewer than eleven dock seeds are distributed over every square yard.

The occurrence of the seeds of clover dodder is still more serious. No fewer than 76 of the 128 samples of red clover (or 59·3 per cent.) contained the seeds of this pest; 33 of the samples contained Chilian dodder seeds, and of these 18 contained European dodder seed as well. Yet the seed itself is so small that it can easily be screened out of the much larger seeds of red clover without entailing an appreciable loss of good seed. Samples containing even the merest trace of clover dodder seeds, even the infinitesimal quantity of one seed per pound, should invariably be rejected, for once this plant becomes established it is only eradicated with excessive difficulty. Not only does it kill off considerable areas of the current crop, but the crop succeeding at intervals of four or even eight years may also be attacked. This subsequent infection may be brought about by dormant seeds or by the plants tiding over each season by developing on other hosts, such as thistles.

The occurrence of the seeds of Chilian clover dodder is less serious. In the Northern Counties it is said that the parasite entirely fails to establish itself, whilst in the South serious outbreaks of the pest do not appear to be at all general.

The prices for red clover seed collected during 1913 varied from 10*d.* to 1*s.* 8*d.* per lb., and averaged 1*s.* 1*d.* The average real value was 58·1 per cent., yet during this year (1913) seed could be obtained of a guaranteed real value of 98 per cent., at a cost of 1*s.* 3*d.* per lb.!

Cowgrass.— Forty-one samples sold as cowgrass were collected in 1913 and 1914. In general characteristics they were so similar to those of red clover that no detailed account is necessary. Dodder seed occurred in 18 of the samples. In 6 samples the dodder was the Chilian species, in one both Chilian and European, and in the remaining 11 European only.

Prices ranged from 8*d.* to 1*s.* 6*d.* per lb. in 1913, and averaged 1*s.* 2½*d.* for an average real value of 68·8 per cent. The best value obtainable on the market at this time was seed with a guaranteed real value of 98 per cent. at 1*s.* 9*d.* per lb.

White Clover.—The average real values for the seasons 1912-14 were 50·6, 61·3, and 56·9 respectively. The best sample had a germinating capacity of 98·6 per cent., and a purity of 99·6

per cent. whilst the corresponding figures for the worst sample were 4·6 per cent. and 25·4 per cent. respectively. Taking the samples as a whole, the purity was fairly satisfactory, except in one respect, viz., the extraordinary prevalence of clover dodder. In 1912 18 samples out of 31, in 1913 8 out of 30, and in 1914 12 out of 45 contained the seeds of this parasitic plant. Apart from this the commonest weedseeds present were chickweed, forget-me-not, sheep's sorrel, field madder, field pansy, plantain, and mayweed.

The low figures for real value were partly to be accounted for, as in the case of red clover, by the prevalence of old seed which had lost its vitality. A sample of the current year's growth is composed of polished seeds varying in colour from a vivid lemon-yellow to bright orange-brown, whereas samples containing old seed can readily be recognised by their dull appearance and the rusty brown seeds they contain. Some samples, *e.g.*, the one mentioned above with a germinating capacity of only 4·6 per cent., consisted of nothing but old seed (possibly harvested 9 or 10 years previously), whilst others were old seed brightened up by admixture with some of more recent growth.

At the same time, part of the deficiency in the germination figures was due to the presence of considerable percentages of "hard seeds." Samples containing from 10 to 12 per cent. were not infrequent; and one occurred in which the percentage was almost 20. These seeds, though living, fail to germinate immediately owing to the fact that their seed coats are almost impervious to water. If sown, they may lie dormant in the soil till the following season, or even later, and then germinate. From the point of view of crop-production they are consequently of little, if any, more value than dead seeds. Fortunately, methods of rendering the seed coats pervious to water have been discovered, and nowadays several seed firms can supply seed with a guaranteed germinating capacity of 98 per cent.

One case of deliberate adulteration was met with in 1913, seed of a worthless annual clover known as *Trifolium parviflorum** having been mixed with somewhat old seeds of white clover, presumably to give the sample a more attractive appearance. This species can be purchased cheaply from certain Continental seedsmen, and consequently it is as well to look out for its presence when white clover seeds are purchased from dealers in whom one has not complete trust. The seeds are slightly smaller

* See also *Journal*, Vol. XVIII., July, 1911, p. 323.

than those of white clover, and they are either lemon-yellow, orange-brown, or black in colour. Consequently, if black seeds occur in a sample, one may reasonably be suspicious. Careful examination with a magnifying glass will settle the matter once for all, for the seed of *Trifolium parviflorum* has a rough seed coat, whilst that of the true white clover is perfectly smooth.

The prices in 1913 ranged from 10*d.* to 2*s.* 6*d.* per lb., the average for the series collected being 1*s.* 5*d.* per lb. Real values showed a range of 0·6 per cent. to 97 per cent. Yet seed with a purity of 100 per cent., and a guaranteed germination of 98 per cent., could be purchased for 2*s.* per lb.

Alsike.—The results of the analyses of alsike were very similar to those of white clover. Some excellent samples with a germinating capacity of over 98 per cent. were met with, the majority were moderately good, and in each season there were a few excessively bad ones. *The worst, with a germinating capacity of only 0·6 per cent., was obviously many years old, but nevertheless it was offered for sale at 1s. 4d. per lb.* The low figures for the real value percentage (Table I.) are accounted for partly by the age of the seed and partly by the frequency of "hard seeds." These averaged some 10 per cent., whilst in extreme cases 20 to 25 per cent. were present.

The most unsatisfactory feature of the samples, as in the case of the clovers previously described, was the extraordinary prevalence of dodder seeds. Again there is no excuse for it, for though the seeds of alsike are small, those of European dodder (the only dodder present in this case) are still smaller and removable with certainty by the employment of suitable sieves.

Table III. shows at a glance how serious is the state of affairs as regards dodder. The total number of samples examined each year is placed in brackets, and immediately in front of it the number found to contain dodder seeds. The sum total shows that they amount to 167 of the 350 samples tested.

TABLE III.

Seed.	*1912.*	*1913.*	*1914.*	*Total.*
Red Clover	30 (56)	28 (42)	18 (30)	76 (128)
Cowgrass	..	9 (17)	9 (24)	18 (41)
White Clover	18 (31)	8 (30)	12 (45)	38 (106)
Alsike	19 (29)	8 (21)	8 (25)	35 (75)
Total	67 (116)	53 (110)	47 (124)	167 (350)

These seeds are almost invariably sown in the same condition as purchased, so that it would appear that practically half of the land put down to clover each year runs the risk of becoming infected with clover dodder.

For the year 1913, prices of alsike varied from 1*s.* to 1*s.* 6*d.* per lb., and averaged 1*s.* 3*d.* The range of the percentage of real value was the same as that of white clover, namely, 0·6 to 97 per cent. Pure seed, with a guaranteed germination of 98 per cent., was quoted during the year at 1*s.* 6*d.* per lb.

Sainfoin.—Thirty-nine samples, some milled and some in the husk, were collected in 1912 and 1913. The purity throughout was excellent, ranging from 96 to 100 per cent. The result, however, is not typical, for whilst milled seed is almost invariably pure, that in the husk is often badly contaminated with the seed of burnet.

The germinating capacity, on the other hand, was far from satisfactory. The best sample of the whole series showed a germinating capacity of 89 per cent., the average was 38 per cent., there were several below 10 per cent., and one in which every seed was dead.

The presence of "hard seeds," amounting to about 12 per cent. on the average, accounts to a certain extent for the deficiencies in the germinating capacity, but the main cause was to be found in the age of the seed. Taking the whole set together, half of the seeds (100 per cent., less 38 + 12 per cent.) had perished during the five years they had been in store. A noteworthy feature of the germination tests was the difference between milled seed and that in the husk, the milled seed being distinctly inferior in this respect.

Trefoil.—Fifteen samples of this seed were collected in 1913. Their germinating capacity varied from 14 to 92 per cent., whilst the real value averaged 67·9 per cent. Prices ranged from 6*d.* to 1*s.* 6*d.* and averaged 11½*d.* per lb. The cheapest samples at 6*d.* and 8*d.* per lb., whilst reasonably free from impurity, were very deficient in their germinating capacity, which only amounted to 14 or 15 per cent.

Mangold.—The real value for the seeds of mangold during the two years in which it was tested averaged 116·4 and 116·7. In this case the real value is the same as the germinating capacity, since the samples had a purity of 100 per cent. The extreme values were 191 and 49.

The results, though far from the best obtainable, cannot be considered bad, for, at ordinary rates of sowing, seed of an average real value of 116 would provide a full plant. Further, as far as can be gathered from germination trials, the seeds were very true to type.

Prices in 1912 ranged from 8*d.* to 1*s.* 8*d.* per lb., and averaged 1*s.* 2*d.* per lb., whilst in 1914 the average price was 10*d.* and the extremes were 6*d.* and 1*s.* 1*d.* The prices proved a poor index to the actual value of the seed, for the cheapest samples were by no means the worst. In fact the single sample of seed offered at 6*d.* per lb. had a germinating capacity of 130 per cent., or 14 per cent. over the average for the two seasons.

Grass Seeds.

The grass seeds proved to be better than those of the various clovers. Samples of cocksfoot, foxtail and Italian and perennial rye grass were obtained in 2 years and Timothy grass in 1 year only. In addition, one or two samples were taken of sheep's fescue, hard fescue, meadow fescue, tall fescue and crested dogstail.

Italian Rye Grass.—The 37 samples of the 1912 series had a real value of 79·2 per cent., and the 24 samples collected in 1913 of 72·5 per cent. Several of the samples showed over 90 per cent. germination, whilst the purity occasionally reached 100 per cent., the lowest value for purity being 65 per cent. The extreme figures for the germinating capacity were 97 and 46 per cent.

When the fact is taken into consideration that empty seeds, or chaff, are reckoned as an impurity, the average value for the purity (93 per cent.) was satisfactory. Apart from chaff the main impurities were seeds of soft brome grass and, more rarely, of Yorkshire fog.

The prices, ranging from 4*d.* to 8*d.* per lb., corresponded approximately with the real value of the samples. In 1913 pure seed with a guaranteed germination of 97 per cent. was obtainable at 35*s.* per cwt., or 3¾*d.* per lb.

Perennial Rye Grass.—The results of the analyses of 46 samples of this species were very similar to those of the Italian rye grass. The real value was slightly lower, averaging 72·5 and 71·8 per cent. respectively in 1912 and 1913, owing to a slightly lower average value for the germinating capacity.

Four samples sold as perennial rye grass consisted of Italian rye grass, and in one case the sample was a mixture of the two species.

The usual price quoted was 4*d.* per lb. In 1913 the best quality, with a bushel weight of 28 lb. and a guaranteed germinating capacity of 97 per cwt., was obtainable at 28*s.* per cwt., or in smaller quantities at 3½*d.* per lb.

Cocksfoot.—The 16 samples taken in 1913, and 20 in 1914, had average real values of 66·0 and 63·1 per cent. respectively, whilst

the germinating capacity ranged from 22—92 per cent. The purity of the samples was satisfactory, since practically all of the impurity present consisted of small quantities of empty seeds. The one serious fault to be found was with the age of some of the samples. Freshly harvested seed should germinate over 90 per cent., and whilst this figure was reached fairly frequently, many of the samples gave a value of only 60—70 per cent.

In 1913, the prices quoted for the cocksfoot seed sampled ranged from 8*d*. to 1*s*. 4*d*. per lb., with an average value of 11*d*. per lb. At the same time cocksfoot seed with a guaranteed germination of 95 per cent. was obtainable at 1*s*. per lb.

Foxtail.—The real values for 15 samples collected in 1913 and 13 in 1914 worked out at 46·9 and 51·4 per cent. The result, at first sight, is unsatisfactory, but in reality it is better than anticipated. This is due to the fact that most of the machinery used for cleaning this seed fails to make even an approximately complete separation of the empty from the seed-filled chaff. As the empty chaff constitutes an impurity the values for purity are generally considerably below those of other agricultural seeds. The highest value was 89·4 per cent., and the lowest 7·9, chaff in each case constituting practically the whole of the impurities. The germination of this seed is also often faulty, and consequently the fact that half of the samples reached as high a value as 80 per cent. was distinctly satisfactory. The germinating capacity ranged from 0 per cent. to 88 per cent.

The prices for the various lots sampled varied from 8*d*. to 2*s*. per lb., and averaged 1*s*. 3*d*. In 1913 seed with a germinating capacity of 85 per cent. was priced at 1*s*. 4*d*., but the only indication given of its purity was a statement of the bushel weight. This amounted to 14 lb., a figure only obtainable with highly-cleaned seed.

No other set of samples shows as clearly as that of foxtail the value of testing samples of seeds before purchasing in quantity. Judging from the prices asked, one would have considered a sample offered at 8*d*. per lb., when the average cost was practically twice as great, to be more or less worthless. In this case, however, one of these, the cheapest of the samples, gave on analysis a germinating capacity of 80 per cent., a chaff content of 24 per cent., and purity 74 per cent., or real value 59·2 per cent. On the other hand, a sample priced at 1*s*. 2*d*. per lb. might be expected to show better results, yet one such sample was found on analysis to consist of 84 per cent. chaff, 7·9 per cent. of pure seeds, and 8 per cent. of other seeds, such as York-

shire fog, soft brome, hair grass, and cocksfoot. The germinating capacity of the pure seed after a month's trial was nil.

Timothy.—Thirteen samples of the seeds of this grass were examined in 1913. The seed is generally of a high degree of purity, and the germinating capacity of samples of recent origin rarely falls below 90 per cent. The average real value for all of the samples was 92·6 per cent., whilst the germinating capacity varied from 90·3 to 99 per cent. The results are entirely satisfactory.

Other Grass Seeds.—Of the other grass seeds examined little can be said. The samples were too few to be representative, and were species which are not usually stocked by the smaller dealers. They are used in relatively small quantities for the preparation of grass seed mixtures intended for the most part to occupy the land for at least three years, and sometimes for an indefinite period. They included wood meadow grass, crested dogstail, sheep's fescue, meadow fescue, hard fescue, and tall fescue. The results of the analyses were, on the whole, good.

Seed Mixtures.—Further analyses bearing on the supply of grass seeds ordinarily available were made of samples of mixed seeds, sent for the most part by farmers directly to the Board of Agriculture and Fisheries. These consisted of 8 samples intended for a one year ley, and 29 for temporary, and 12 for permanent pastures. In some cases the purchasers had drawn up their own prescription for the required mixture, and in others had left it to the discretion of the vendors, merely stipulating the prices they were prepared to pay per acre.

Each mixture was separated out into its component species, and where practicable the amounts of the various seeds present were compared with the amounts ordered. Estimates were also made of the percentage of weed seeds present. The average quantity of impurity present, including chaff, worked out at 3·7 per cent. The impurities were for the most part harmless, with the exception of clover dodder, which occurred in 10 of the 49 samples examined. In one of the samples *Trifolium parviflorum* was present to the extent of 2 per cent. With one exception the mixtures were suitable for the purposes for which they were wanted. The exception was a mixture containing 19·5 per cent. of useful species, 7·5 per cent. of sand and grit, and the remaining 73 per cent. weed seeds and chaff. It was probably nothing more than the sweepings of a hay-loft.

General Conclusions.—The results of the inquiry show clearly that whilst abundant supplies of agricultural seeds of the highest

quality are obtainable, there is still a considerable market for seeds of a far lower grade, and even for seed which cannot possibly yield a satisfactory crop. Further, as a comparison of the prices will show, seed of the best quality does not, as a rule, cost much more per pound than the average price as determined for each of the kinds dealt with. Under these circumstances, it seems extraordinary that seeds which are often obviously bad should ever be purchased.

The reasons often given for buying the poorer grades of seeds are worth examining in some detail. Perhaps the commonest is that cheap seeds are good enough for the land on which they are to be sown, the implication being that the land is so foul that a few extra weeds do not matter. Whilst one recognises that some land is certainly difficult to keep reasonably clean, there is no reason why the matter should be made still more difficult and the yield of subsequent crops curtailed by the growth of an additional crop of weeds. The 4 or 5 per cent. of weed seeds frequently occurring in the samples of white clover or of alsike made singularly little difference to their general appearance, but an admixture on this scale might well be responsible for sowing as many as 50 weed seeds on every square yard of a field. Even if only one-half germinated, and if one-half the resulting plants were crowded out of existence by the clovers, there is a notable addition to the weed-content of the land. Moreover, if the cleaning processes to which the bulk of the seed has been subjected have been carried out so inadequately it is, in the case of the clovers, very probable that many of the seeds of the parasitic clover dodder remain from which the crop may suffer considerably.

The same argument does not apply so strongly in the case of the majority of the grass seeds, since the impurities are mainly empty seeds and fragments of flowering stems. Even here, however, the better germinating capacity of the highest grade samples makes their employment more economical.

Another reason frequently given for the use of poor seeds is that seeds of the best quality are too expensive for sowing for the production of ordinary crops, however suitable they may be for the production of further seed crops. In the majority of cases the reasoning is false, and the truest economy is to purchase the best seed obtainable. The fact may be illustrated by comparing the relative values of the average red clover samples examined in 1913 and a pure sample. The prices were 1*s*. 1*d*. and 1*s*. 3*d*. per lb. respectively, the real value of the former being 58·1 per

cent., and of the latter 100 per cent.* In the *best sample* there were some 215,000 germinable clover seeds per lb., so that each penny purchased $\frac{215,000}{15}$, or 14,333 "good" seeds. The *average sample* contained some $\frac{215,000 \times 58 \cdot 1}{100}$, or 124,915 germinable clover seeds per lb., and hence 1*d*. purchased only $\frac{124,915}{13}$, or 9,609 "good" seeds. The expenditure of an extra 2*d*. per lb. therefore gave an additional 14,333—9,609, or 4,724 seeds for every 1*d*. expended.

Thus, economy is secured by the fact that a lower seeding-rate per acre can safely be used if the best quality of seeds are sown. Thus, assuming that 10 lb. of the *best quality, i.e.*, 2,150,000 seeds are sufficient per acre, the cost would be 12*s*. 6*d*. To sow a similar quantity of the *average seeds* would require $\frac{2,150,000}{124,915}$ or, roughly, 17 lb. of seed costing 18*s*. 5*d*.

This is by no means an extreme case, for some of the worst samples of red clover had so low a percentage of real value that a seed-rate amounting to over one ton per acre would have been necessary to secure sufficient clover seeds to provide a full plant!

From the data obtained from the analyses similar examples could be multiplied almost indefinitely. Without considering others, however, the general statement may be made that the higher-priced samples, especially if offered under a guarantee of germinating capacity, usually contained a larger number of germinable seeds per lb. than those sold at lower prices. Apart altogether from this, the samples which at first sight seemed the most expensive usually had the advantage that they were comparatively free from weed-seeds and other impurities, except in the case of such seeds as mangold or milled sainfoin, which usually have a purity of 100 per cent.

Reviewing the results of the 676 analyses as a whole *the relative cheapness of the guaranteed seeds as compared with the average of those collected indiscriminately from all kinds of dealers is perhaps the most noteworthy fact.* As already indicated, a few exceptions occurred and bargains could be found here and there, though these were not bargains the ordinary purchaser could pick up, for an analysis was necessary before their value became evident. Moreover, they were so rarely met with that their existence offers no prospect of finding them without devoting far more attention to searching for them than the saving in price would warrant.

* This sample did not occur amongst those collected by the Board's Inspectors. It was purchased as pure and with a guaranteed germination of 98 per cent. The analyses showed a purity of 100 per cent. and a germinating capacity of 100 per cent.

SEED TESTING, AND THE NEED FOR DESTROYING WEEDS.

Seed Testing.—The preceding article, by Professor Biffen, shows only too clearly the need which still exists for farmers to exercise the greatest possible care in purchasing their seeds. The Board desire to impress upon farmers the great importance at the present time of taking steps to ensure that there shall be no failure of crops due to the sowing of poor seed. An article dealing with "Seed Testing for Farmers" was published in this *Journal* for March, 1915, p. 1098, and a leaflet (Special Leaflet No. 24, *Seed Testing*) was subsequently issued, indicating to farmers that it is worth their while to make certain that the seeds they sow are good.

Cases showing the kind of loss which may occur are quoted in the leaflet, but an example may be given here. A Herefordshire farmer last year seeded down a field with red clover. In the autumn he discovered that the parasitic weed dodder* was overrunning the field, and the probability is that the field will have to be ploughed up and reseeded. This is both a disappointment and a loss which could easily have been avoided, free of cost, by submitting a sample to the County Agricultural Organiser for examination before accepting and using the seed. Nevertheless, though the importance of ascertaining that the seeds bought are suitable for sowing is generally recognised, all too few farmers submit samples to the Agricultural Colleges and County Agricultural Organisers for examination and report.

At the East Anglian Institute of Agriculture, Chelmsford, the plan has been adopted, in making a seed report, of stating the number of weeds per acre or square yard which might grow on sowing the clover or grass seeds examined. Thus, a clover seed sample might be reported on as follows:—

Clover Seed. Sample 14. Weed Analysis.

Total Weight.	Dock.	Plantain.	Lychnis.	Wild Carrot.
10 grammes	6	161	2	1
1,000 ,, ...	600	16,100	200	100
6 kilogrammes	3,600	96,600	1,200	600
or 13·2 lb.	,,	,,	,,	,,

"If 13·2 lb. of this seed be sown per acre the weeds which will spring up over the field as a result will be: Plantain, 20 plants per sq. yd.; dock, 3 plants on every 4 sq. yd.; lychnis, 1 plant on every 4 sq. yd."

Such figures possibly show even more clearly than the percentage of purity would do the extent to which fields may become infested by sowing seeds containing weed seeds. The percentage of purity in the case quoted was about 97, and might suggest a high-class red clover seed. The weed figures, however, show that it is not so good as it appears.

Apart from the direct loss in money when low-grade seeds are purchased, and the resultant poor "plant" which is almost certain to follow when they are sown, a point of very considerable importance is the fact that many weeds are introduced on to fresh farms with impure seeds. When it is stated that the cash value of the seeds of the principal farm crops sown in Great Britain may amount to about *7 millions sterling* per annum, it will be realised how much loss may be incurred by the inclusion of only a very small proportion of weed seeds or by using seed of low germinating power, and how very necessary it is that this immense quantity of seed (for some 12,000,000 acres) should be as pure as it is possible to make it, and of high germinating capacity so that the crop quickly covers the soil.

At the present time it is most important that the maximum yield of foodstuffs should be obtained from the land under the plough, and this can only be done by keeping the land in a high state of cultivation and sowing pure seed of high germinating power.

Farmers should submit samples of the seeds they purchase, under guarantee and subject to analysis, to a competent agricultural botanist at one of the Agricultural Colleges or to a County Agricultural Organiser, and only accept the bulk on his recommendation to do so. Instructions as to sampling, labelling, etc., should first be asked for from the expert concerned. Data as to the addresses to which farmers may send samples are given in the Table on pp. 1057—1060. It is very desirable that samples should be submitted as early as possible, in order that good time may be given for the test to be completed before the seed is purchased or sown as the case may be. Replies cannot satisfactorily be given immediately samples are submitted for examination, some days at least being required for a test in regard to germinating power. Purity only may be reported on at once. Every farmer who has not yet read the Board's Special Leaflet No. 24 (*Seed Testing*) should immediately send for a copy,* and act on the advice therein given.

* It may be obtained free from The Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W. The letter or post card of application need not be stamped.

Statement as to Seed Testing in Various Districts of England and Wales.

Address to which samples may be sent for examination, and counties served by each Centre.	Facilities for Seed Testing.	Fees payable.	Extent of Seed Testing in past 5 years.	Information given by Complete Report on a Seed sample.	Whether the Seed Testing conducted in the past 5 years has led to any improvement in the seeds supplied by seedsmen.
Professor R. H. Biffen, M.A., School of Agriculture, Cambridge University. *(Bedford, Cambridge, Essex, Hertford, Huntingdon, Isle of Ely, Lincs [Holland and Kesteven], Norfolk, Northampton, Soke of Peterborough, E. and W. Suffolk).*	Ample	None charged to farmers of counties named.	In the year 1914-1915, 21 samples were tested.	Purity (and percentage of grit, &c., chaff, and weed seeds in detail), percentage germination.	Samples insufficient to base any conclusions on.
Professor J. Percival, M.A., University College, Reading *(Berkshire, Buckingham, Dorset, Hampshire, Isle of Wight, Middlesex, Oxford.)*	Complete equipment	Nominal to farmers in counties named.	Farmers have not yet availed themselves of the seed-testing facilities to any large extent.	Statement as to purity and impurities, germination capacity (also hard seeds and dead seeds).	—
T. J. Jenkin, B.Sc., Agricultural Dept. (Advisory Section), University College of North Wales, Bangor. *(Anglesey, Carnarvon, Denbigh, Flint.)*	—	Seeds are tested free of charge for farmers in the counties named.	Started in 1913: 1913, 70 samples; 1914, 52 samples; 1915, 300 samples.	Purity and germination, with particulars of impurities.	Too soon to say.
W. B. Mercer, B.Sc., Armstrong College, Newcastle-on-Tyne. *(Cumberland, Westmorland, Durham, North-*	—	Practically no charge.	Year ended 30th September, 1915—161 samples tested fully and 103 samples partially.*	Percentage of purity; nature of impurities; percentage of germination; energy of germination; real value.	It is satisfactory to note that the practice of giving a guarantee with seeds is steadily increasing.

Address to which samples may be sent for examination, and Counties served by each Centre.	Facilities for Seed Testing.	Fees payable.	Extent of Seed Testing in past 5 years	Information given by Complete Report on a Seed sample.	Whether the Seed Testing conducted in the past 5 years has led to any improvement in the seeds supplied by seedsmen.
W. Goodwin, M.Sc., Ph.D., Midland Agricultural and Dairy College, Kingston, Derby. (*Leicester, Derby, Lindsey, Nottingham, Rutland.*)	The temporary Botanical Laboratory is well equipped for the purpose.	No regular scale; free for *bonâ-fide* farmers.	Started in 1913: †1913, 23 samples; †1914, 102 samples; †1915, 97 samples.	Percentages of purity and *germination*; classification of impurities with approximate percentages of chief constituents. Written remarks on general character of sample, including an opinion on value of seed for purpose desired.	Difficult to state *definitely*, but results have probably been good.
P. Hedworth Foulkes, B.Sc., Harper Adams Agricultural College, Newport, Salop. (*Salop, Stafford, Warwick.*)	Two germinators and greenhouse.	1*s.* for complete report for farmers, 2*s.* for others (within counties named).	From 50 to 80 per annum, nearly all "Complete Report."	Purity, germination, real value, average weight of seed, indication of principal weed seeds present in sample.	Yes; but there is a great deal of apathy amongst farmers on the question of seed testing.
T. J. Young, M.Sc., F.S.I., College of Agriculture, Holmes Chapel, Cheshire. (*Cheshire.*)	Biological Laboratory provided with germinators.	A nominal one of 2*s.* 6*d.* for examination and report.	Twenty-five for complete report.	The names of the constituents, their percentage of germination and advice as to general suitability for any particular purpose.	Yes, it seems to have kept before users the necessity *of* obtaining seed' from high-class firms who deal in seed of high quality, and germination.
S. T. Parkinson, B.Sc., South-Eastern Agricultural College, Wye, Kent (*Kent, Surrey, E. and W. Sussex.*)	Ordinary methods, *including* use of special germinator, but not the equipment for a special seed-testing station.	1*s.* 6*d.* for a complete report.	Very few samples sent in, and *those* usually cereals. Average, 15 to 20 samples per year	General remarks on the sample (weight, &c.), *reference* to noxious weeds, purity test, germinating energy and capacity.	Judging from the few samples sent it is *unlikely that much* improvement can have occurred. On the other *hand*, farmers are, perhaps, more particular in obtaining guarantees than was formerly the case

[illegible] Anglian Institute of Agriculture, Chelmsford. (*Essex and Hertford.*)		[illegible] purity, germinating power, and on the nature and proportion of foreign substances.	but the demand has been small, probably about a dozen samples a year. In 1915 the number was 19.	(*b*) report on germination capacity, including energy of germination; (*c*) report on nature of impurities, and their effects (harmful or otherwise). The form of report recommended by the Agricultural Education Association is being adopted.	any appreciable effect.
J. D. Davidson (Principal), The Farm Institute, Sparsholt, Winchester. (*Hampshire.*)	No definite facilities, but tests are made if required.	Germination test, 6*d*. Germination and purity test, 1*s*.	—	Germinating capacity, germination energy, purity of sample.	The work in seed-testing has been on a small scale.
W. Borlase, N.D.A., Cornwall Agriculture Department, County Hall, Truro. (*Cornwall.*)	In connection with the advisory work farmers are invited to submit samples of seeds for analysis. (Students in the Winter Agricultural Schools learn to identify all the seeds used on the farm—grasses, clovers, etc. At all centres samples are examined for purity, and the germination test is explained.)	Gratis	An average of about 150 samples per season. (104 samples in 1915).	The report on the sample sent gives in full detail the names and the percentages of all seeds present. Germination results are sometimes given when deemed advisable, and there is sufficient time.	Yes, very great improvement. "Farmers are much more careful now in the purchase of seeds than they were two years ago, having learnt that it is better to pay a good price for seeds than to buy the lowest-priced samples irrespective of quality." (1914 report.) "In some cases on the receipt of the analysis the farmer has refused to accept seeds for which he was negotiating, and one farmer returned seeds he had already purchased . . . It is only fair to add that many local firms are evidently doing their utmost to persuade farmers to purchase only seeds of high quality." (1915 report.)

Address to which samples may be sent for examination, and Counties served by *each* Centre.	Facilities for Seed Testing.	Fees payable.	Extent of Seed Testing in past 5 years.	Information given by Complete Report on a Seed sample.	Whether the Seed Testing conducted in the past 5 years *has* led to any improvement in the seeds supplied by seedsmen.
F. V. Dutton, County Agricultural Laboratories, 1, Richmond Road, Exeter. (*Devonshire.*)	(At the County Laboratories, Exeter).	1*s*. per sample for a report.	18 samples for complete report.	Purity, germination, true value, weight of seed, germinative energy.	Out of 10,000 farmers in the county only 10 have sent samples during the last 5 years.
John Porter, B.Sc., Shire Hall, Hereford. (*Hereford.*)	(Agricultural Education Office.)	Free	About 6 samples in 1915 for the farmers; much work done for students.	Purity, quality, and germinating capacity.	Rather difficult to say. The samples tested have usually been satisfactory.
J. H. Burton, M.Sc., Agricultural Education Office, Weston-super-Mare. (*Somerset.*)	(Analyses conducted by Mr. Burton.)	Free of charge ..	Forty-three for complete report. (3 years.)	Per cent. germination; per cent. purity—if sufficiently important, nature of principal impurities.	Hardly. Not sufficient done to influence the trade. Mr. Burton has not time to concentrate on the work or to try and get a large number of samples. A few farmers, however, have realised the value of seed testing, and send samples every year.

* Of these 264 samples, 59 were received from co-operative societies, 109 from farmers and 7 from seedsmen; while 30 were obtained from Cockle Park and 59 collected by the Adviser in Agricultural Botany.

† Including samples from wholesale seed merchants; seed mixtures purchased on guarantee of composition and germinating capacity supplied by vendors; seeds showing signs of overheating in stock or *during storage*; *old seeds*; seeds *treated with* preparations to prevent fungus and bird attacks; seeds infested with spores of fungus pests; and seeds of low germinating capacity where advice was required as to the quantity to sow per acre.

The Need for Destroying Weeds.—Closely connected with the question of pure seeds is that of foul land, and the Board desire to call the special attention of farmers to the great need for combating weeds, which are usually responsible for great loss in the yields of crops (*See* Leaflet No. 112, *Weeds and their Suppression*). On a properly weeded area the crop may be double that on an unweeded area; *e.g.*, in one case mangolds, grown under otherwise exactly similar conditions on the same field, yielded 37¼ tons per acre where two hoeings were given, and only 16¼ tons where there was no weeding after singling.

Further, a careful estimate has led to the conclusion that the annual loss actually due to the presence of weeds, and to the increased cultivations, etc., necessary to keep them in abeyance, amounts to about 20*s.* per acre in the case of root crops, 10*s.* per acre in the case of cereal, pulse, and other arable crops, 10*s.* on permanent grass, and 5*s.* on rotation grasses, etc., or about 16½ *millions sterling* per annum.

In this connection it may be remarked that in a Memorandum issued last year by the Farmers' Club it is observed that, "The biggest waste in agriculture is caused by weeds. As a rule, weeds are permitted by bad farmers only, and a determined attempt, notwithstanding all difficulties, should be made to get rid of the weeds so that the yield per acre of the crops we grow may attain the highest standard."

The general means available in normal years for the destruction of weeds are detailed in Leaflet No. 112 (*Weeds and their Suppression*). In view of the fact that a larger acreage than usual of cereal crops was grown last year, and is likely to be harvested in 1916, special precautions should be taken to prevent weeds getting the upper hand. Apart from mechanical means of destroying weeds usually practised, several points are especially deserving of notice:—

(1) Seeding of all weeds should be prevented by all possible means.

(2) All perennial weeds should be cut down frequently to exhaust the supplies of food stored up in their roots, and prevent storage of further supplies.

(3) An endeavour should be made to prevent weed seeds separated out in the course of threshing and winnowing and the refuse seeds from haylofts from again reaching the fields. Wherever possible these should be burnt. Farmyard manure, believed to contain weed seeds in any quantity, should be allowed to rot well before application to the land. Many weed seeds

may be present when meadow hay and chaff (barren glumes) of oats are fed to stock.

(4) In certain cases, where hand-hoeing is largely practised, corn crops may usefully be drilled in rows wide enough apart to permit of horse-hoeing, say, 8 in. to 9 in. apart. This is especially useful in the case of spring-sown corn.

(5) Where horse-hoeing cannot be practised, the wetter the climate, or the more the land is subject to the growth of annual weeds, the closer the drill coulters should be set. When weeds are plentiful it is advisable immediately after harvest to disc or lightly scarify the surface, with a view to encouraging the germination of annual weeds. These should afterwards be ploughed down.

(6) Where weeds are likely to be abundant it may also prove a good plan to sow part of the root "break" with a vetch mixture in autumn. This would not only "smother" out weeds but reduce the labour bill for roots.

Under the Norfolk four-course rotation the area devoted to roots imposes a severe strain on labour, even in normal times. At the present time, all indications point to the necessity for modifying the usual practice. It is well known that success in root-growing and the welfare of the crops that follow depend largely on careful, thorough, and persistent cultivation of the root "break." It is desirable, therefore, that farmers should adopt every practicable means of suppressing weeds at all stages of the rotation, as, for example, by the growth of heavy corn crops, and they should include in the root area such crops as will suppress weeds, save labour, and provide suitable supplementary keep for stock in winter. (*See* Special Leaflet No. 28, *Suggestions for the Cultivation of Catch Crops and Home-Grown Feeding Stuffs*, and Special Leaflet No. 43, *Suggestions for Saving Labour.*)

Labour.

During the past year, no doubt largely owing to shortage of labour, weeds were unusually plentiful in many districts.

The shortage in manual labour may largely be met in so far as the destruction of weeds is concerned by the employment of women and children, working when necessary in gangs in charge of one or two older and practised hands; and of temporary workers who may be in a position to do work of this kind for short periods. In regard to labour, farmers should make much fuller use of the local Labour Exchanges.

TRIALS OF WILD WHITE CLOVER.*

DOUGLAS A. GILCHRIST, M.Sc., F.R.S.E.,

Professor of Agriculture, Armstrong College, Newcastle-upon-Tyne.

AFTER seeing the results of trials conducted near Chester, the writer commenced trials with Wild White Clover in North Wales in 1893, but, as he moved to Reading in 1894, these trials were not followed up. The trials commenced near Chester in 1886 would undoubtedly have been more successful if basic slag had been used, as at Cockle Park, for the development of this plant. One of the seeds mixtures then used near Chester had previously given good results in Kent. Perennial rye grass, crested dogstail, and wild white clover made up the Kent mixture, which gave a good sole of grass and a close sward of white clover in the first year, which attracted the favourable attention of many farmers who visited the plots. In order to show how the cost of wild white clover seed has increased since the first trials were made at Cockle Park, it may be noted that the price per pound was 1*s.* 6*d.*, or rather over, from 1906 to 1910; 2*s.* 10*d.* in 1911; 4*s.* 3*d.* in 1912; 3*s.* 6*d.* in 1913; 3*s.* in 1914; and 7*s.* in 1915. There are indications that, for 1916, prices may vary from about 14*s.* to 20*s.* a pound. The production has steadily increased, but not at all in proportion to the demand.

Trials at Cockle Park.—The first trial of wild white clover at Cockle Park was begun in 1906. A small area of the poorest type of boulder clay soil in Tower Hill Field had been summer fallowed in 1905 and sown with wheat that autumn. In April, 1906, plots (among others) were sown with the following seeds (per acre):—

	Plot I.	*Plot II.*
Perennial Ryegrass	6 lb.	6 lb.
Italian Ryegrass	6 ,,	6 ,,
Cocksfoot	6 ,,	6 ,,
Timothy	3 ,,	3 ,,
Meadow Fescue	8 ,,	8 ,,
Red Clover	4 ,,	4 ,,
Alsike Clover	2 ,,	2 ,,
White Clover	4 ,,	4 ,,
Wild White Clover	—	4 ,,

* This article is in continuation of that which appeared in the issue of this *Journal* for December, 1909, p. 713. It summarises the results of trials with Wild White Clover since that time at Cockle Park, the Northumberland County Agricultural Experiment Station, and endeavours to give some indication of the most valuable results now being obtained throughout the country from its use. Mr. James Hunter, Chester, informs the writer that he first heard of Wild White Clover about thirty years ago, when the trials of grass and clover seeds, referred to in the first article, were made near Chester. The seed of the plant then came from the Weald of Kent, and one or two farmers there continued to save this seed thereafter. Mr. Boddy, Shoreham, Kent, supplied the seed for these trials. He collected ripened [illegible] whipping the re-

These plots have now produced hay for 9 years (1907-1915), with the following results per acre:—

	Plot I., without Wild White Clover. A.—10 cwt. basic slag for 1907, 1910, and 1913.	*Plot I., without Wild White Clover.* B.—No Manure.	*Plot II., with Wild White Clover.* A.—10 cwt. basic slag for 1907, 1910, and 1913.	*Plot II., with Wild White Clover.* B.—No Manure.
	cwt.	cwt.	cwt.	cwt.
1907	39¼	6¾	38	18
1908	23½	5¼	33½	9¾
1909	15¾	8	25½	11
1910	16¼	4¾	39¼	11½
1911	18¼	4½	30¼	9
1912	25½	13	51	13½
1913	25¼	3½	35	4½
1914	22	5	34¾	11
1915	10½	1½	23½	2¾
Av. (9 years)	21¾	5¾	34½	10

The poverty of the soil is strikingly shown by the fact that, where no manure was applied and no wild white clover was sown, the average crop of hay for 9 years was only 5¾ cwt. an acre.

Wild white clover, without manure, increased the average crop of hay to 10 cwt., still an unsatisfactory result. On this plot, however, the wild white clover plants are now quite plentiful, but have a hard struggle for existence.

Where no wild white clover was sown, basic slag gave an excellent result in the first year, mainly because of its stimulating effects on the cultivated clovers. These, however, died out after that year. The nitrogen collected by their roots, however, helped the grasses considerably, especially in the following year, and by 1912 wild white clover plants, native to the soil, commenced to occupy part of the ground in patches. Yet even in 1915 these native plants have not covered the soil in anything like the satisfactory way that the sown wild white clover has done.

Where high-grade basic slag was applied and wild white clover was sown, it will be seen that 12¾ cwt. more hay has been produced per acre annually than where slag was applied but no wild white clover was sown, while in addition the aftermath has also been much more valuable.

These plots show in the most decisive manner the lasting effects of wild white clover and the need for this plant being manured with a phosphatic manure like basic slag on a poor clay soil of this character. The lime of the slag is probably useful, as well as the phosphates.

A plot sown with the same seeds mixture containing wild white clover, and dressed with 10 tons of dung per acre every third year, has given an average of 30⅝ cwt. of hay during the 9 years, so that basic slag, at half the cost of dung, has given about 4 cwt. more hay per acre annually. Another plot sown [illegible]

the same dressings of basic slag and dung conjointly, with the result that on the average 1¼ cwt. less hay per acre has been given by slag and dung than by slag alone. It should be specially noted that cocksfoot and other grasses were much more vigorous, and of a darker green colour, when growing with clover than by themselves in the first year's hay, as early as June, 1907.

It is clear that wild white clover, in common with other clovers, will give its best result if manured with a phosphatic manure like basic slag, and a potash manure if the land is deficient in that substance; and also, that grasses growing with clovers very soon benefit from association with them, probably because of the nitrogen collected by the clover roots.

About 4 acres of clay of the poorest character, which had previously failed to grow any crop in a satisfactory manner, was summer-fallowed in 1906 and sown with wheat for 1907. This land was sown in the same spring with the seeds mixture given on page 1063 (Plot II.), containing wild white, but no ordinary white clover. Ten cwt. per acre of high-grade basic slag were applied for 1908, and again every third year thereafter. For the 8 years, 1908-1915, the average amount of hay grown per acre has been 36 cwt., while valuable aftermath, rich in clover, *and wild white clover alone*, has been grown in each year.

As a result of these trials about 7 acres of the poor clay soil at Cockle Park have been sown every year since 1909 with a seeds mixture for three years containing wild white clover. In every case the nurse crop has been barley, receiving no manure, while the previous root crop received dung alone, 12 tons per acre. In the early winter, after each barley harvest, 10 cwt. per acre of high-grade basic slag (39 per cent. phosphates) *alone* have been applied on the young seeds. The following table shows the weight of hay produced per acre for three years thereafter in four successive periods of three years:—

First Year.		*Second Year.*		*Third Year.*	
Year.	cwt.	Year.	cwt.	Year.	cwt.
1910 ..	57½ ..	1911 ..	31 ..	1912 ..	49¼
1911 ..	29¼ ..	1912 ..	43¾ ..	1913 ..	47¼
1912 ..	36 ..	1913 ..	49¼ ..	1914 ..	41¼
1913 ..	52 ..	1914 ..	52 ..	1915 ..	29
Average	43¾	Average	44	Average	41¾

These results justify the conclusion, arrived at in 1909, that the poor clay land under cultivation at Cockle Park should be put under a six-course rotation, and that seeds hay should be taken for three years in succession, in the manner described above. This poor clay soil had previously failed to grow cultivated

Garden had shown that clovers can easily be choked out by too thick a sowing of grasses, while the meadow hay plots in Palace Leas Field had shown that 24 per cent. of clovers could be developed in the herbage by applications of basic slag and a potash manure, whereas, when sulphate of ammonia was added to the foregoing, clovers were so repressed that only 6 per cent. of them were present in the herbage.

The above results, for four three-year periods in succession, fully demonstrate that the proper use of wild white clover and basic slag will produce crops of hay of over 2 tons per acre annually on land on which it was not possible to grow as much as half these quantities before, while the aftermaths are more than doubled in value, and are as good in the second and third years as in the first, and contain more clovers.

The seed mixture used for growing these crops of hay practically consisted per acre of the following:—

16 lb. Perennial Ryegrass.
10 ,, New Zealand Cocksfoot.
4 ,, Timothy.
4 ,, Singlecut Cowgrass.
$1\frac{1}{2}$ to 4 lb. Wild White Clover.

The seeding of the last has been reduced, owing to its high cost, to $1\frac{1}{2}$ lb. per acre (and a small amount of alsike clover and trefoil substituted), as it has been repeatedly found elsewhere that this quantity of seed is ample when a good take of seeds can be secured. Incidentally it should be noted that New Zealand cocksfoot and singlecut cowgrass have especially valuable characteristics.

Trials in Aberdeenshire.—Mr. James Cruickshank, Port Erroll, Aberdeenshire, sowed, in 1910, an 8-acre field in poor condition with a seed mixture which included 1 lb. of wild white clover. He did not notice any special result till 1913, when the field was grazed. In that year this plant gave a close and green sward till the end of the grazing season, and it was estimated that it produced double the amount of pasture of any field on the farm. This good result was continued in 1914. In January, 1915, he gave it a heavy dressing of basic slag, and, as a result, he reports that the pasture has simply been splendid in 1915. He has now sown many of his fields with seed mixtures containing wild white clover, which are all developing well.

In 1910 samples of wild white clover were sent to over 80 members of the Agricultural Students' Association of Aberdeen University. By the third year it was reported that this plant was producing an excellent sole of pasture, when the seeds were grazed. In one case in 1913 oats were grown after a two years' ley, and the crop proved to be far more vigorous after wild white clover than when this was not included in the mixture. In 1914,

two of the members thrashed equal areas of oats which had been grown after ley, sown with, and without, wild white clover. At one of the centres 60 bush. per acre of oats were grown after wild white clover and 52 bush. after ordinary white clover. At the other centre the amounts of grain were 68 and 50¾ bush. respectively.

Other Trials of Wild White Clover.—The excellent crops of oats after a three years' wild white clover ley are most satisfactory at Cockle Park.

At Mr. Wardle's farm, Fallowfield, near Hexham, the oat crop was increased by over 14 bush. per acre in 1913, when it followed a wild white clover ley, instead of a ley on which ordinary white clover was sown.

Mr. George Rea, North Doddington, Wooler, Northumberland, has included wild white clover in seed mixtures on Mr. Charles Mitchell's Home Farm, Pallinsburn, Northumberland, with the result that the first and second years' seeds were of a most satisfactory character in 1915. They were grazed and carried a heavy stock with excellent results. Wild white clover herbage was abundant throughout, and the bulk and nutritive value of the grasses were evidently greatly improved by their association with clover.

Mr. J. Cleghorn, who has made known with energy the merits of this plant in North Northumberland, *and how it should be treated,* reports that Mr. Waugh, Duddo, obtained a greatly increased yield of oats after wild white clover, and that Captain Lambton has marvellously improved his rotation pastures by its use in the Glenvalley, close to the Cheviots.

Dr. Voelcker has obtained striking results with it on the Royal Agricultural Society's Station at Woburn.

Mr. Murray Thomson reports that Mr. Parkin Moore has greatly improved his pastures at Whitehall, Cumberland, by its use.

Mr. J. P. F. Bell, Fulforth, County Durham, has obtained, on large areas, crops of hay and aftermaths on temporary leys, and increased crops of oats thereafter, of as satisfactory a character as those at Cockle Park.

Results of an equally good character are being given, not only throughout the four northern counties of England, but in all parts of the United Kingdom. One of the most satisfactory results is that the period of many years which formerly existed between the sowing down and the making of a pasture practically disappears when wild white clover is properly used.

Securing Seed of Wild White Clover.—The seed of true wild white clover can only be obtained with certainty from pastures that have been laid away for a considerable number of years, and on which no seeds have been sown during that time. A safe

limit would probably be 20 years since the pasture was laid down. On such pastures wild white clover can frequently be developed to a large extent by the proper application of basic slag or other phosphatic manure, with probably the addition of a potash manure if the soil is of a light character. It is important to note that wild white clover should be the particular wild clover present in such pastures. If there are many plants of wild red clover, or yellow suckling clover, or other such plants, the wild white clover seed will contain a considerable amount of these seeds.

"Once grown" wild white clover has given quite satisfactory results, and is found to retain the characteristics of wild white clover. This "once grown" wild white clover is produced from leys in which true wild white clover is the only clover used in the seeds mixture. When wild white clover seed is thus obtained it is most important that the original seed should be that of true wild white clover, so as to ensure that any such seed should not be more than "once grown" from true wild seed. Professor M'Alpine, of the West of Scotland Agricultural College, found that up till the third generation the plants produced from such seed have the true wild characters. This has also been shown in the College Garden at Newcastle. At the same time it is not desirable that seed offered to the public should be more than "once grown" from the true wild form. Mr. J. H. Marshall, Bebside, Northumberland, has saved sufficient wild white clover seed from an old meadow for the last 5 years to serve his own purposes, and in 1915 has harvested 10 cwt. of this valuable "once grown" seed from a ley in its fourth year, thus showing that this seed can be harvested quite satisfactorily in Northumberland. He grazed this ley till 1st June in 1915 thus securing a larger proportion of clover to grass plants when the ripened clover was cut for seed early in September. A second cut of clover in the same season is too late to mature seed in Northumberland, as it will usually do in the counties further south, where clover is harvested for seed purposes.

As the cost of the seed is likely to be high for 1916, only small quantities can be sown per acre. At Cockle Park 1 lb. per acre has given quite a close and satisfactory aftermath after first year's hay, so that even ½ lb. per acre is likely to give good results, provided that the seeds are sown under the best conditions of tilth, and that the young plants are developed by a manure like basic slag. The attention of growers of clover seed has been drawn by the writer to the importance of this plant, and there is every likelihood that the supply of it, either in the original or "once grown" form, will be much more abundant

LINSEED AS A FARM CROP.

COMMUNICATED BY THE BRITISH FLAX AND HEMP GROWERS' SOCIETY, LIMITED.

LINSEED, either in the form of ground linseed or as linseed cake, has long been regarded as a food of special value for farm stock, more especially for milking cows and fattening bullocks, and as a "finishing off" food it seems to be quite unique. Ground linseed is of great importance in the rearing of calves. At the price to which these commodities have risen during recent years they have become so expensive as to preclude their general use on such a scale as would be desirable. The question, therefore, arises whether the farmer can grow linseed for his stock at a smaller cost than the price he must pay for it under existing conditions.

The encouragement and development of linseed growing in this country has been undertaken by the British Flax and Hemp Growers' Society, Limited, and information has been collected and experiments have been conducted to ascertain the best variety to grow and the prospects of growing this crop at a profit to the farmer. Although the experiments are not yet concluded, the circumstances of war are causing a growing scarcity of linseed and its products, so that it seems desirable to place on record the facts in support of the conclusion that on suitable soil, with the right kind of seed, considerable profit may be made by growing linseed as a farm crop.

General Considerations.—The constituents of linseed which are of chief value to the farmer from the point of view of a food-stuff are the *oil* and the *protein*, the popular opinion amongst farmers being that it is the oil in the linseed cake which has the special property of giving "bloom" to the coats of animals, and which keeps them "in condition" in a way that no other cake does. For this reason farmers are always ready to pay more for a cake rich in oil than for one that is poor in oil. The value of the protein in the seed, both from the feeding and the manurial standpoints, must not be overlooked. It is interesting to find from an examination of a large number of samples that, generally speaking, those samples which are rich in oil contain a large proportion of protein and those which do not contain so much oil are also more deficient in protein.

The constituent of linseed which is of chief value to the factor, from the point of view of crushing, is the *oil*. It may be said, therefore, that samples of linseed which contain the highest percentage of oil are of the greatest value to the farmer

as a foodstuff and also to the crusher as a source of oil. The rational way of valuing linseed, therefore, is on its oil-content : oil per acre from the farmer's point of view and oil per ton from the factor's point of view.

Owing to the fact that flax (*Linum usitatissimum*) is grown not only for the seed it bears (*linseed*) but also for the fibre which is contained in the stem (*line*), some confusion exists in the minds of farmers as to the kind of seed to sow for raising a linseed crop. It can be stated definitely, however, that seed which is usually sown in Ireland, Belgium, Holland and North Russia for the purpose of raising crops of tall, single-stem flax plants for fibre production are not the kinds best suited for the production of linseed. For the latter purpose a type of flax plant is required which exhibits a branching habit, produces abundance of seed, and which does not grow to a height of more than from about 18 in. to 2 ft.

With the object of deciding upon the best variety or kind of linseed to sow, a large number of samples from different parts of the world have been examined in the laboratory and in the field during the past four years. Of those which have been tried, four kinds, namely, *Moroccan*, *La Plata*, *Dutch* (*white flowering*) and *Steppe* seed proved to be the most promising, and these have been grown in various parts of the country on trial plots of ¼ acre arranged in duplicate, so that the area devoted to each kind of seed was ½ acre at each centre.

The results recorded in Table II. show that in each case the seed known in the trade as " Plate " or " La Plata " linseed has proved to be the best suited where a linseed crop is desired.

Farmers are sometimes deterred from attempting to grow linseed owing to the belief expressed by some writers that the climate of this country is not suitable, and that linseed grown at home contains appreciably less oil than that which is usually imported. There being very little reliable information upon which to base such a statement, it has been necessary to examine a large number of samples of imported linseed, to grow them in this country and examine them again. Typical results are given in Table I., and it will be seen that there is no foundation for the belief that linseed grown in England is in any way inferior in oil to the imported samples from which it is raised ; indeed, in some cases the results show an increase in the oil content as well as an increase in the weight of the individual seeds, and, as a whole, the figures compare favourably with the average—40·7 per cent.—of 52 samples of Indian-grown linseed.

TABLE I.—*Showing Relation between Imported Linseed and Linseed Grown in England.*

Variety of Seed.	Imported, 1912.		English Grown, 1913.	
	Oil Content.	Weight of 1,000 Seeds.	Oil Content.	Weight of 1,000 Seeds.
	Per cent.	Grms.	Per cent.	Grms.
Moroccan. Mazagan (London market)	40·60	10·166	42·90 (Wye) 40·13 (Camblesforth) 39·06 (Seale-Hayne) 40·86 (Harper Adams)	13·098 13·538 11·132 13·392
Plate. (London market)	38·45	6·108	42·80 (Wye) 39·69 (Camblesforth) 37·72 (Seale-Hayne) 41·35 (Harper Adams)	8·840 9·204 7·712 8·744
Dutch. White-flowering (London market)	35·49	4·817	37·69 (Wye) 35·08 (Camblesforth) 34·60 (Seale-Hayne) 36·71 (Harper Adams) 34·08 (Holmes Chapel)	5·410 4·810 4·066 5·164 3·904
Steppe. Russian (Liverpool market).	38·90	5·076	41·50 (Wye)	7·198

Considerations of Soil.—Linseed requires no special kind of soil; it flourishes well on any good medium land. Provided that the land is clean, its selection is of minor importance compared with its proper preparation prior to sowing the seed. Although it may be said that land which is clean and well adapted to the cultivation of barley is suitable for linseed, the best results are obtained on a medium loam where the sub-soil is stiff—a good wheat bottom being eminently suitable.

Place in Rotation.—In linseed-growing countries many different rotations are adopted, a good practice being to grow the crop after corn. Wheat does well after linseed, and linseed does well after wheat, and it is the usual custom to grow linseed after a straw crop of some kind. Where the soil is light, however, it is best to make it follow a root or green crop which has been fed off by sheep.

Although it not infrequently happens where the land is poor that linseed is taken after clover, it is better to sow it with

clover or " seeds " underneath. This practice has the distinct advantage that the clover benefits by the small amount of shade offered by the linseed crop and at the same time weeds are kept in check.

Most authorities agree that the crop should not be grown frequently on the same land, because a condition of soil sickness sets in. The usual interval between two crops is about seven years.

Preparation of the Land.—Great stress must be laid upon the necessity of having the land deeply worked and firm, with but a shallow surface layer to cover the seed after sowing. This is of importance, because the linseed crop grows very rapidly—the growing period extending over some ten weeks only—and the most desirable conditions are those which cause this rapid growth to be both continuous and uniform. To obtain these conditions the land should be deeply ploughed in the autumn or early winter and be allowed so to remain until near the time of sowing. Suitable cultivations should be carried out prior to sowing in order to obtain a firm seed-bed and a fine tilth.

Manuring.—It is not desirable to sow linseed on land which is in a very high state of fertility, because such conditions induce luxuriant growth without a proportional increase in the amount of seed produced. For this reason, when farmyard manure is used it should be applied to a previous crop rather than for the immediate benefit of the linseed crop.

There is very little information regarding any advantage arising from the application of artificial manures in the case of this crop. It is not at all certain that the treatment recommended for flax when grown for fibre is the most suited to the requirements of the seed crop. As far as the Society's experiments have gone it seems that the yield of seed is increased somewhat by the application of superphosphate in conjunction with potash—*e.g.*, 3 cwt. of superphosphate and 1 cwt. of sulphate of potash per acre—applied just prior to, or at the time of, sowing the seed.

Generally speaking, however, unless the soil is poor, no very marked increase in the quantity of seed is brought about by the application of artificial manures; certainly no change of the oil-content of the linseed is brought about by these means. It is no longer seriously maintained that flax is an exhausting crop in the sense that it draws more from the land than do other crops.

Variety of Seed to Sow.—The selection of seed for sowing purposes is an important matter, as it is very necessary to employ only the very best seed, choosing that which is bright, plump and clean. The best plan is to choose one's seed merchant with care, so that one may be reasonably confident of getting the best quality seed on the market.

Of the several types of linseed which may be grown profitably in this country as a seed crop, experience goes to show that the best is that known as *La Plata* or *Plate Linseed.* This is one of the medium large-seeded varieties which grows to about 2 ft. in height and exhibits a marked tendency to branch at the base. When both yield of seed and oil-content are taken into consideration, *Plate Linseed* is found to be a better type to grow than either *Moroccan Linseed, Steppe Linseed* or *Dutch White Flowering Linseed.*

When making use of these imported seeds for sowing purposes it is necessary either to dress the seed carefully to free it from weed seeds, or to stipulate that this must be done by the merchant, otherwise serious trouble may be encountered by sowing foreign weeds on the farm.

TABLE II.—*Relative Merit of Varieties of Linseed Grown.*

Varieties.	Yield of seed per acre.		Per cent. oil.	Oil per acre.	Oil per acre (Plate=100).	Relative order.
	cwt.	lb.		cwt.		
Wye—						
Moroccan	12	25	42·9	5·24	84	3
La Plata	14	70	42·8	6·25	100	1
Dutch	11	80	37·7	4·43	71	4
Steppe	13	53	41·5	5·61	89	2
Harper Adams—						
Moroccan	8	67	40·9	3·51	96	3
La Plata	8	97	41·3	3·64	100	1
Dutch	9	74	36·7	3·54	97	2
Camblesforth—						
Moroccan	5	67	40·1	2·24	92	2
La Plata	6	12	39·7	2·43	100	1
Dutch	4	74	35·1	1·63	67	3
Seale-Hayne—						
* Moroccan ..	1	21	39·1	0·47	35	2
* La Plata ..	3	63	37·7	1·34	100	1
* Dutch	0	106	34·6	0·33	25	3

* At this centre the season was a very wet one, and great difficulty was experienced in harvesting and drying the crop.

Time of Sowing.—The best plan is to sow as early as possible—as soon as the soil and weather will permit—so that the seed will germinate slowly and have a good start while moisture is in the top soil.

Linseed is a crop which is rather easily affected by drought in its early stages of development.

Fear need not be entertained that moderate frost will damage the plant—it is quite able to withstand several degrees of frost without injury.

Usually it is possible to sow on light land at the end of March or the beginning of April, but on heavier land it is seldom possible to get the seed sown before the end of April. There are, however, many varying influences which have to be taken into account and only the farmer can say when his land is in suitable condition for receiving the seed; the matter of importance being to get it in as early as possible so that advantage may be taken of the early linseed harvest to get a catch crop on the same land, unless clover or "seeds" has been sown in the first instance.

Mode of Sowing.—As with other crops, the seed may be sown either by broadcasting or by drilling, but owing to the slippery nature of the seed it is seldom possible to effect uniform hand distribution except by experts. This means that broadcast sowing is generally best accomplished by using the fiddle.

Drilling possesses the distinct advantage that it ensures the seed being buried at a uniform depth and it facilitates the cleaning of the crop by hoeing. A light corn drill may be rendered suitable for the purpose by setting the coulters as close together as 6 in. If "seeds" are to be sown underneath they should be put in immediately after the linseed is sown, and in this case the linseed may also be sown by means of a seed-barrow.

It is desirable to have the seed buried only to about ½ in. or 1 in. below the surface, light harrowing followed by light rolling being all that is necessary after sowing.

Rate of Sowing.—When deciding at what rate per acre to sow linseed, it is necessary to take into consideration (1) the germination capacity of the seed; (2) the size of the seed; (3) the habit of the plant; and (4) the method of sowing.

The importance of knowing the percentage of dead seeds in any sample of seed sown will be obvious to all farmers, and with linseed it is particularly desirable to have this information, because bad storage may impair the vitality of the seed very considerably. The following are the average percentages of live seeds found in the samples of imported linseed which have been examined:—

Variety.	Germination, per cent. 1913.	Germination, per cent. 1914.	Variety.	Germination, per cent. 1913.	Germination, per cent. 1914.
	Per cent.	Per cent.		Per cent.	Per cent.
Plate seed ..	72	100	Steppe seed ..	94	100
Moroccan seed..	98	100	Dutch " ..	92	37

The size of the individual seeds must also be taken into consideration, because the seeds of some varieties, such as that coming from Morocco, may be twice as large as others, *such as that coming from Holland.*

Variety.	Weight of 1,000 seeds. 1913.	Weight of 1,000 seeds. 1914.	Variety.	Weight of 1,000 seeds. 1913.	Weight of 1,000 seeds. 1914.
	grms.	grms.		grms.	grms.
Plate seed ..	5·98	6·10	Steppe seed ..	4·91	5·07
Moroccan seed..	9·96	10·16	Dutch " ..	4·25	4·81

It will be seen from the above table that, if the germination percentage of these varieties were the same, a given weight of the largest grained variety (Moroccan) would give less than half the number of plants that would be given by the same weight of Dutch seed. This is obviously of great importance, although it is a point which is seldom taken into consideration.

It is also desirable to bear in mind that some varieties of linseed differ in habit from others; for instance, Dutch seed, and to a less extent Moroccan seed, give plants which show little tendency to branch at the base—being, in this respect, unlike Plate seed. This means that to get a full crop less seed of the last variety may be used.

It is generally understood that drilling requires less seed than broadcasting, and it is unnecessary here to do more than mention the fact.

The following are the quantities of seed per acre which would be required for broadcast sowing when the germinating capacity in each case is that already given for 1914:—

Plate seed ..	91 lb.	Steppe seed ..	86 lb.
Moroccan seed ..	166 lb.	Dutch " ..	219 lb.

Weeding.—Provided the land is moderately clean it is not so necessary to weed the crop carefully as is customary when flax is grown for fibre. Where the seed has been drilled

it is usually sufficient to hand hoe once and to keep the larger weeds down by spudding.

It is desirable to remove gross weeds, such as dock, thistles, convolvulus, and dodder, at an early stage. Linseed being a crop which affords less shade to the ground than other grain crops it frequently happens that weeds make considerable headway unless clover or "seeds" are sown underneath.

Harvesting.—Linseed continues to flower for some time and consequently ripens unevenly—the plants carrying ripe and green capsules even at harvest time. This fact is not detrimental to good harvesting, because, like wheat, it ripens in the "shock." It is everywhere agreed that the best practice is to harvest linseed when the stems have turned yellow and the lower leaves have fallen. At this stage an examination of the seeds within the older capsules shows them to be bright, plump, and uniformly pale brown in colour. This degree of ripeness is generally reached at about the middle of July, prior to the ordinary corn harvest.

It is not wise to allow the crop to stand until the majority of the capsules are dead-ripe, because considerable loss of seed thereby ensues when the crop is harvested. Careful handling is more necessary with the linseed crop than with other grain crops, because the seed "bolls" become entangled and are easily detached from the straw.

If the area of linseed is small it is obviously the best course to cut it with a scythe, but with larger areas an ordinary reaping machine requires very little adjustment to deal with the crop satisfactorily. The sheaves should be made up small so as to allow drying to proceed rapidly, and they should then be "shocked" in the ordinary way, and carted when thoroughly dry.

Threshing.—The best method of threshing linseed at the present time is to use an ordinary threshing machine, and to achieve the best results the following adjustments are recommended. About two-thirds of the cavings riddle should be covered with a piece of sacking to prevent any large amount of the cavings falling through the riddle along with the seed and chaff. The ordinary size riddle being large enough as to allow unbroken seed "bolls" to pass through with the seed, a three-sixteenth-inch "chob" riddle is recommended. The unbroken seed "bolls" should be passed through the drum a second time. Unless the drum of the machine be set close and a high speed be maintained, and the straw be carefully fed into the machine, the straw may have to be put through a second time to remove all the seeds.

Linseed being much smaller than the seed of other grain crops, only the finest riddles should be used.

Where only a small area of linseed has to be dealt with, threshing may be accomplished with a flail or by beating with a sloped mallet such as is used in Holland and Belgium. The latter has the advantage that threshing is completed in one operation, all the capsules being broken and the seed set free, whereas, when a flail is used a considerable number of the "bolls" remain whole although detached from the straw, so that it is necessary to crush them to liberate the seed.

After either of these modes of threshing has been followed, the seed can be freed from chaff and cleaned thoroughly by passing it through a winnowing machine fitted with the finest riddles.

Yield.—In Table III. will be found the results of the trials which were carried out during the two years 1913 and 1914.

TABLE III.

Yield of Seed, Straw, and Chaff per acre, 1913.

Centre.	Soil.	Variety.	Seed sown 90 lb. per acre of all varieties.					
			Seed.		Straw.		Chaff.	
			cwt.	lb.	cwt.	lb.	cwt.	lb.
South-Eastern Agricultural College, Wye, Kent.	Good medium loam.	Moroccan	14	32	13	28	9	0
		La Plata	16	108	17	27	8	56
		Dutch ..	13	40	23	84	8	14
		Steppe ..	14	84	23	56	8	84
	Poor chalk.	Moroccan	10	15	8	91	6	70
		La Plata..	12	32	12	84	5	70
		Dutch ..	10	9	18	14	7	98
		Steppe ..	12	22	15	42	7	98
Harper Adams College, Salop.	Free working loam.	Moroccan	8	61	10	14	7	84
		La Plata..	8	98	9	56	7	0
		Dutch ..	9	71	18	20	7	70
Camblesforth, Selby, Yorks.	Light sand.	Moroccan	5	68	10	84	9	0
		La Plata..	6	12	8	98	7	0
		Dutch ..	4	81	13	42	9	70
Glasfryn, Carnarvonshire, N. Wales	Medium light loam.	Moroccan	4	84	12	63	6	70
		La Plata..	8	98	16	0	6	105
		Dutch ..	6	42	22	2	9	70

TABLE III.—(*cont.*).

Yield of Seed, Straw, and Chaff per acre, 1914.

Centre.	Soil.	Variety.	Seed sown varied with each variety.* Seed.	Straw.	Chaff.
			cwt. lb.	cwt. lb.	cwt. lb.
South-Eastern Agricultural College, Wye	Medium loam. chalky.	Moroccan	12 84	11 16	9 28
		La Plata..	13 8	11 96	9 84
		Dutch .	10 104	14 56	9 47
		Steppe ..	10 80	15 16	8 0
Harper Adams College. Salop.	Good free working loam.	Moroccan	14 58	21 26	12 56
		La Plata..	16 96	21 11	7 60
		Dutch ..	10 64	21 18	8 30
		Steppe ..	15 96	21 11	7 54
Midland Agricultural College.	Light loam.	Moroccan	9 70	Not weighed.	Not weighed.
		La Plata..	10 33		
		Dutch ..	8 21		
		Steppe ..	10 18		
Cambridge School of Agriculture.	Medium loam.	Moroccan	7 14	10 42	7 68
		La Plata..	7 48	11 84	8 16
		Dutch ..	4 6	15 100	6 0
		Steppe ..	7 12	14 0	7 16
Royal Agricultural Society, Woburn.	Sandy loam.	Moroccan	9 91	15 85	Not weighed.
		La Plata..	10 9	14 10	
		Dutch ..	5 110	20 103	
		Steppe ..	7 53	17 52	

* Seed per acre :—Moroccan, 140 lb. ; La Plata, 85 lb. ; Steppe, 70 lb. ; Dutch, 200 lb.

Straw and Chaff.—Linseed straw is remarkably tough and wiry and rots down very slowly, and for this reason it does not make good litter for stock. There are, however, several ways of using it profitably. On the farm the straw is useful for making stack-bottoms, or for the bottom of covered yards. It is also very useful for thatching purposes, and lasts much longer than either wheat or rye straw.

The straw coming from the ordinary threshing machine is somewhat broken and tangled ; but if this is put up into press-packed bales it may be sold at the present time at about £4 to £5 per ton.

A very good tough paper can be made from linseed straw, and although at present there is only a limited demand for it

for this purpose, it is probable that if larger quantities were forthcoming it would be more seriously considered by paper makers and advantage would accrue thereby to the growers.

The chaff of linseed consists almost entirely of the remains of the broken seed capsules. It may be fed to stock in the same way as other grain chaff, ewes being particularly fond of it. It should be observed, however, that as the chaff contains a considerable amount of fibre, it is not very suitable for young stock, more particularly lambs.

Cost of Growing and Returns.—The cost of growing, on the lines indicated, should not exceed £6 per acre. The figures obtained in the two years' experiments referred to in Table III. show that when using "La Plata" seed a crop of about 17 cwt. of seed containing 40 per cent. oil may be expected under favourable conditions, and that the average crop from the five centres where it has been grown during the past two seasons amounts to 11 cwt. of dressed linseed.

At the present time, when the price of linseed is £21 per ton, an average crop should be worth £11 10*s*. per acre without taking into account the straw or the chaff.

The yield of straw has varied between 21 cwt. per acre at Harper Adams in 1914 and 9 cwt. per acre on the light sandy soil near Selby in 1913, the average for all centres being 13½ cwt. per acre. As already stated this can be sold at the present time if put into press-packed bales at £4 to £5 per ton. There is, in addition, about 7½ cwt. of chaff per acre which has been sold recently at £3 per ton. The value of the straw and chaff therefore may be put at nearly £4 per acre, which brings up the total value of the linseed crop to £15 10s. per acre.

When a small area has been grown for use on the farm for calf rearing or as a substitute for linseed cake it may be crushed or ground into a meal. It is probable that when ground it is in its best form, and in this state the "feed" is more easily prepared.

It must be pointed out that linseed cake is the residue of linseed after expressing the greater part of the oil, and that linseed is, therefore, much richer in oil than is the cake, as will be seen from the following figures:—

Analysis.	Moisture.	Digestible Oil.	Digestible Protein.	Digestible Carbohydrates and Fibre.
	Per cent.	Per cent.	Per cent.	Per cent.
Linseed (whole) ..	9	38	17	21
" cake ..	12	9·5	25	32

One of the most satisfactory and economical ways of using linseed when grown for home consumption, apart from its use in calf rearing, would be to prepare a food mixture similar in composition to that of a good sample of linseed cake. This can be done by mixing together 2½ parts by weight of ground-nut cake, 1½ parts by weight of maize and 1 part by weight of linseed. The feeding value of such a mixture compares quite favourably with that of linseed cake, as may be seen from the following figures. At the present prices of the added materials, ground-nut cake and maize, it is estimated that such a mixture would be a more valuable food and would cost £1 10s. per ton less than linseed cake.

	Digestible Oil.*	Digestible Protein.	Digestible Carbohydrates and Fibre.	Cost.**
	lb.	lb.	lb.	£
2½ tons ground-nut cake*	465	2,240	1,120	30 0 0
1½ tons maize ..	151	235	2,284	19 10 0
1 „ linseed† ..	851	381	470	11 0 0
5 tons mixed food ..	*1,467*	*2,856*	*3,874*	*60 10 0*
1 ton mixed food ..	*293*	*571*	*775*	*12 2 0*
1 „ linseed cake..	212	560	717	13 13 9

* Kellner's figures of digestible nutrients have been taken.

† These figures refer to samples mentioned in Table on p. 1079. The cost is the cost of growing as estimated above.

** London prices for ground-nut cake, maize and linseed cake (*see* p. 1150).

Grinding Linseed.—The question arises how best to grind linseed, because it sometimes happens when the grinding surfaces are of stone that the mill becomes clogged unless some absorbent material is added. The best material to mix with linseed for this purpose is previously crushed maize in the proportion of not less than one part of maize to five parts of linseed. This facilitates grinding by absorbing the oil which becomes pressed out of the linseed during the grinding operation.

WILLOW-GROWING AND BASKET-MAKING AS RURAL INDUSTRIES.

HENRY P. HUTCHINSON, B.Sc.,

Midland Agricultural and Dairy College, Kingston, Derby.

THE term "basket-willows" defines those species of plants of the genus *Salix* which are grown for the making of basket-ware. In habit of natural growth they may be regarded as shrubs or bushes, and by this character they are readily distinguishable from tree-willows, which, when allowed to grow freely, become timber trees.

Amongst growers, merchants and makers, basket-willows are divisible into two main groups, viz.: (1) *Hard rods*, (2) *Soft rods*. These are only relative terms, but sufficiently intelligible to all handlers of willows, and indicate the main difference existing between the two classes. The "hardness" of any variety of rod is determined by its *working qualities* when in the hands of the basket-maker, and depends upon the proportions of wood and pith in the stem, as well as upon the character of the wood elements. "Hard rods" belong to the species *triandra* and *purpurea*, and "soft rods" to the species *viminalis*.

Rods of the two former species are finely tapering at their apexes, while in the case of the last the tips of the rods are more abruptly pointed. For this reason in some places the terms "fine tops" and "full tops" are used for distinction. Amongst a few the same two groups are distinguished as "willows" and "osiers," but in general these terms, particularly the latter, are used without regard to species.

The area of land devoted to willow cultivation in this country is not accurately known. The most important willow-growing districts are in Somerset (Langport district), in the Trent Valley, and in Lancashire (Southport district). Many acres are grown in Cambridgeshire and the adjoining counties, and also in the Thames and Severn Valleys.

The supply of home-grown material is not sufficient to meet the requirements of the English basket manufacturing industry, as the following figures regarding imports of basket-making willows show[1]:—

*Value of the Total Imports of Willows and Canes for Basket-making—Free of Duty.**

From :	1910.	1911.	1912.	1913.	1914.
	£	£	£	£	£
Germany	30,366	33,698	38,211	34,246	26,983
Netherlands	9,702	14,781	14,109	19,569	25,773
Java	3,005	7,058	4,911	10,477	12,269
Other Dutch Possessions..	8,177	7,292	1,754	7,896	7,297
Belgium	7,925	11,160	12,614	12,288	8,416
Other Foreign Countries ..	6,509	7,538	6,851	9,798	10,896
Total for Foreign Countries	65,684	81,527	78,450	94,274	91,634
Strait Settlements and Dependencies, including Labuan	14,360	21,091	17,747	28,852	33,349
Other British Possessions..	5,842	3,678	1,514	347	496
Total	85,886	106,296	97,711	123,473	125,479

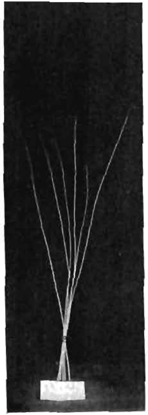
There is scope for an increased production of English-made basket-ware, the annual importations being as given below.'

Value of the Total Imports of Baskets and Basket-ware—Free of Duty.

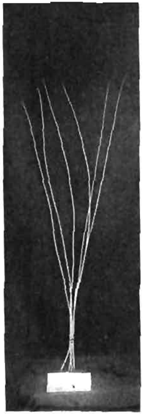
From :	1910.	1911.	1912.	1913.	1914
	£	£	£	£	£
Germany	40,409	42,413	42,001	40,344	20,456
Netherlands	45,187	45,128	43,692	43,302	50,265
Belgium	52,127	51,717	52,741	52,162	37,099
France	19,502	21,072	19,428	19,689	12,271
Switzerland	2,367	2,456	1,864	1,145	410
Portugal	3,674	4,437	4,972	4,846	2,839
Japan, including Formosa and Japan-leased Territories in China	27,066	33,216	55,071	61,108	37,955
Other Foreign Countries..	5,064	3,675	4,614	6,295	3,855
Total for Foreign Countries	195,396	204,114	224,383	228,891	165,150
Total from British Possessions	925	2,047	1,501	1,196	1,771
Total	196,321	206,161	225,884	230,087	166,921

As to exports, the value of the basket-ware (the manufacture of the United Kingdom) exports amounted in 1914 to £21,178. The exports of willows and canes for basket-making (the produce of the United Kingdom) are so small as not to be separately

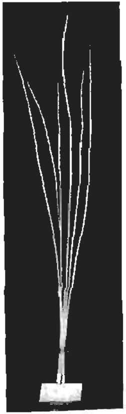
* It should be noted that the materials imported from the tropics for basket-making are canes and not willows, but it is probable that they might be replaced by willows in many forms of basket-ware.



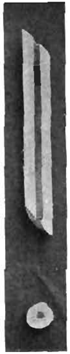
C.—*Salix purpurea.*
var. *Dicky Meadows.*



B. *Salix triandra.*
var. *Black Maul.*



A. *Salix viminalis.*
var. *Longskin.*



S. viminalis (*Merrins*).
Longitudinal
and Transverse
Sections.

S. triandra (*Italiano*).
Longitudinal
and Transverse
Sections.

distinguished in the Annual Statement of Trade. The *re-exports* of willows and canes for basket-making were valued in 1914 at £7,330, and of baskets and basket-ware at £4,559.

Of late years many willow grounds have passed out of cultivation. These were mostly in the hands of small men who, in many cases, were also basket-makers. Various reasons are adduced to account for this decrease, the chief being:—(1) Increased cost of labour, (2) high rents, and (3) depression in the local basket-making trade.

Large basket-manufacturing firms and big growers, particularly in Somerset, have increased their areas and will probably continue to do so. Records of the market transactions in rods show a progressive rise in price since 1840. In that year "white" was sold at Sutton-on-Trent at £7 10*s*. per ton. In 1860 the price of rods of the same quality was £16 per ton, the seller paying carriage to Glasgow (about 55*s*. per ton). In 1914 the price of similar material was about £22 per ton. At the present time prices are high owing to the fall in the quantity of imported rods, and £42 per ton was recently paid for some fine quality "white."

Soil.—The soil best suited to the growing of willows is a rich, well-watered, heavy loam. The same kind of land does not suit all varieties of willows, even those closely related, equally well, but generally the greater the divergence from this type of soil the less likely is success to follow. Such land is capable of producing heavy yields of the best varieties for 30 or 40 years after planting. In a suitable season the rods would be of good quality, being esteemed by the basket-maker on account of their smoothness, toughness, elasticity, great length in proportion to thickness, freedom from side shoots, good colour either as "buff" or "white," and straightness in the grain.

Willows are generally grown on the low lands bordering on streams. No other crop is as suitable to periodically flooded land, and in regard to economic husbandry this is its right place. Willows will thrive on land situated above flood level provided it be maintained in good condition. Many acres of highly-rented pasture land so situated have been planted by enthusiastic growers with good results. It is claimed by basket-makers that these "high land willows" possess qualities superior to those of willows grown under any other conditions.

Preparation of Soil.—Details of cultivation and management of the crop, as practised by the best growers, are given in a publication issued by the Board.[2] The preparation of new ground to be planted is generally commenced in autumn or early winter.

distinguished in the Annual Statement of Trade. The *re-exports* of willows and canes for basket-making were valued in 1914 at £7,330, and of baskets and basket-ware at £4,559.

Of late years many willow grounds have passed out of cultivation. These were mostly in the hands of small men who, in many cases, were also basket-makers. Various reasons are adduced to account for this decrease, the chief being:—(1) Increased cost of labour, (2) high rents, and (3) depression in the local basket-making trade.

Large basket-manufacturing firms and big growers, particularly in Somerset, have increased their areas and will probably continue to do so. Records of the market transactions in rods show a progressive rise in price since 1840. In that year "white" was sold at Sutton-on-Trent at £7 10*s.* per ton. In 1860 the price of rods of the same quality was £16 per ton, the seller paying carriage to Glasgow (about 55*s.* per ton). In 1914 the price of similar material was about £22 per ton. At the present time prices are high owing to the fall in the quantity of imported rods, and £42 per ton was recently paid for some fine quality "white."

Soil.—The soil best suited to the growing of willows is a rich, well-watered, heavy loam. The same kind of land does not suit all varieties of willows, even those closely related, equally well, but generally the greater the divergence from this type of soil the less likely is success to follow. Such land is capable of producing heavy yields of the best varieties for 30 or 40 years after planting. In a suitable season the rods would be of good quality, being esteemed by the basket-maker on account of their smoothness, toughness, elasticity, great length in proportion to thickness, freedom from side shoots, good colour either as "buff" or "white," and straightness in the grain.

Willows are generally grown on the low lands bordering on streams. No other crop is as suitable to periodically flooded land, and in regard to economic husbandry this is its right place. Willows will thrive on land situated above flood level provided it be maintained in good condition. Many acres of highly-rented pasture land so situated have been planted by enthusiastic growers with good results. It is claimed by basket-makers that these "high land willows" possess qualities superior to those of willows grown under any other conditions.

Preparation of Soil.—Details of cultivation and management of the crop, as practised by the best growers, are given in a publication issued by the Board.[2] The preparation of new ground to be planted is generally commenced in autumn or early winter.

The land is dug one spit, or trenched with the spade, or ploughed by means of horse or steam power. The method adopted depends upon the kind of labour available, the condition, shape and size of the ground to be planted, and the time of year when the operation is carried out. Good single-spit digging answers well in many cases. Trenching, which results in the reversal of positions of the upper and lower spits, is considered to be the best treatment, but it is a slow method and the cost (from 3*s.* to 5*s.* 6*d.* per 100 sq. yds.) makes it prohibitive. Where the ground is too irregular in shape, or too wet for the employment of horses or steam tackle, single spit digging and trenching are the only methods possible to adopt. Ploughing is resorted to when the acreage to be planted is large and a rapid completion of the operation is necessary. Steam cultivation, if properly done, is the most satisfactory method. The main object to be attained by this operation is to break up the subsoil to a depth of 12 or 14 in., and to secure a fine mould on the surface so that the insertion of the cuttings may be easily and expeditiously carried out.

Draining.—It is necessary during this stage to lay out a drainage system. This may be done by means of trenches or grips, pipe drains, or by a combination of the two methods. Surface drainage by means of trenches is usual on account of its general suitability to the circumstances, and the soil from the trenches is deposited on the intervening lands. In pipe-draining the pipes are either laid so as to give a "fall" or placed on the level. In the latter case the water in them rises and falls with the level of the water in the water-course into which the drain empties itself.

Probably more failures to grow desirable sorts of willows are due to an excessive amount of water in the soil than to any other cause. The water supply should be carefully studied before it is decided to plant new land. Frequent and heavy floodings are not harmful if followed by free drainage. An excessive supply of soil water causes purple and yellow discolorations to appear in the leaves, which afterwards fall prematurely, and the seasonal growth is poor.

Varieties to Plant.—Those varieties should be planted which are likely to prove most profitable to the grower. A basket-maker having willow ground grows the varieties which his business requires, and in cases where a constant local demand for rods of a particular type exists it is generally good policy on the part of a grower to cater for it.

A much wider market is open to rods of good than to rods of poor quality, and with such material substantial profits will remain

after expenses attending long railway transit have been paid. In making a selection of varieties for the planting of untested land, a prospective grower with little previous experience should seek and follow the best expert advice procurable. For basket-making purposes three species of willow are generally cultivated, viz.:—

1. *Salix viminalis* (*Osiers, Full tops, or Soft rods*).—Many varieties of this species are grown, of which the following only need to be considered in making a selection: Longskin, Yellow Osier, Merrin, French Osier, Reed Osier. The varieties of this species are characterised by their heavy yields, their adaptability to varied soil conditions, and the low quality of the rods which they produce. When one-year-old, the rods are used in the making of the coarsest kinds of basket ware. As "sticks," *i.e.*, rods which have been allowed to grow for two or more years, they are largely used as the main supporting parts of the heavier classes of articles.

2. *Salix triandra* (*Fine tops, or Hard rods*).—Many varieties exist, of which at least 20 are cultivated. The multiplicity of names due to local nomenclature and to *mutations* is perplexing in classification, but the following are well known and include the best of the varieties: Black Mauls, Black Germans, Italians, French, Stonerods, Glibskins, Dutch, Champions, Norfolks and Spaniards. Rods of the finest quality are produced from some varieties, and these are used in the making of the highest grades of wicker-ware.

3. *Salix purpurea* (*Bitter willows*).—Probably not more than 250 acres of this species are grown in this country, and most of this area is grown in the Southport (Lancashire) district. The chief commercial variety cultivated is the "Dicky Meadows," from which three sub-varieties have probably been obtained by selection, viz., Light Dicks, Dark Dicks, and Old Dicks or Red Buds. The varieties are said to succeed on sandy loam.[3] The rods are highly suitable for the making of small basket ware of superior quality. "Kecks" is a stronger-growing variety used largely for tying purposes.

Propagation.—In propagation, cuttings are obtained by dividing rods of one or two years' growth into suitable lengths. There does not seem to be any proved advantage in using rods of either age provided they are well grown. The top section of the rod is not planted. The usually recognised length is 12 in., but cuttings 10 in. and up to 16 in. in length are sometimes planted. Long cuttings are preferable in cases where the ground is light and loose and subject to strong winds. A greater encouragement is thus given to the development of a deep root system with corresponding firm hold on the soil.

Planting.—Planting should be done at a time when the ground is conveniently workable between the months of October and March. No planting should take place after sap movements have commenced. From 18,000 to 30,000 cuttings are required per acre, the precise number depending upon the varieties to be planted and the method of after-cultivation to be adopted. For

horse-hoe cultivation a greater distance is required between plants than in the case of hand hoeing. Basket willows grow straightest and freest from side shoots when massed, and experiments prove that close planting gives the heaviest yields, reduces the development of lateral shoots, and greatly retards the growth of weeds[4], but impoverishes the holt sooner[5]. Planting "on the square," *i.e.*, maintaining equidistance between the plants, is practised by some growers. This method gives the advantage of cross cultivation in horse-hoeing, but is not suitable in cases where the field to be planted is irregular in shape and slope and narrow in proportion to its length. Scaling recommends,

for varieties of	*viminalis*	*distances of*	*20 in.*	*by*	*16 in.*
" "	" *triandra*	"	" 18 "	"	15 "
" "	" *purpurea*	"	" 16 "	"	13 "

The rows should be made straight and regular by means of a chain or line or marker attached to an agricultural implement. The cuttings may be pushed into the soft ground at regular intervals in the rows by the hand protected by leather across the palm, and the ground around made firm without damaging the cuttings.

After-Cultivation.—It is essential to success that the ground be kept free from weeds until the plants have become well established. Hoeing by horse-hoe or hand suffices. Three hoeings may be necessary during the first season and two during each of the two seasons following. Afterwards one hoeing is generally sufficient, as the close foliage checks the growth of weeds in summer.

Cutting.—The crop is cut between the months of October and May. Some growers take the first crop after two seasons' growth has been completed. Good first-year crops are frequently grown on the best land, but generally they are of little value on account of the many bent and branched rods present. Such rods, if allowed to remain on the heads until the end of the second season, would still be of poor quality, so that the result of this practice is that no financial returns from the land can be expected until the end of the third growing season. Many good growers always cut their rods during the first winter following planting, claiming that by so doing an opportunity is afforded the plants of producing a profitable crop at the end of the second year. On this point Scaling states[6] that "However poor the crop (maiden) may be, it must be harvested or cut off; for, if it was allowed to stand over until the second year, the united produce of the two years would be entirely worthless."

Cutting is performed by means of a specially constructed knife. The rods should be cut close to the stock and evenly on all sides. If snags are allowed to remain the heads become so unduly raised and outspread that they interfere with processes of cultivation. Badly cut heads also afford hibernating quarters for willow pests. The rods may be cut at any convenient time after leaf-fall and onwards until sap movements begin in the following spring.

Marketing.—The crop is marketed as "green," "buff," "white," or "brown." Freshly-cut rods, or "green," are sold as such in cases where the growers have not facilities for converting them into "white" or "buff." They are used to a limited extent in the making of rough articles in which long durability is not required, such as bottle-crates, cheese-hampers, etc.

The crop in this condition is heavy, and therefore because of high freight charges is not sent long distances. By disposing of the crop as "green" the profits are generally much less than would be realised by converting it into one of the other marketable forms. After cutting, the rods may be tied in bundles, stacked in the open and protected by thatch or a layer of peelings.

"Buff" rods are prepared from "green" rods either freshly cut or which have not become too dry in the stack, by boiling in long tanks, specially constructed for the purpose, for from two to five hours. By this means the tannin matter present in the bark is liberated and acts upon the underlying wood. The length of time of boiling depends upon the variety and the intensity of the colour required. The character of the land on which the rods have grown largely determines the buffing qualities. If grown on firm clay soil a good buffing variety, such as "Black Maul," will buff well after having been boiled for one or two hours, but if grown in a swampy part of the holt or on peaty land the same variety may be pale even after continuous boiling for five hours.

The bark is removed by hand alone, or by hand with the help of fixed "breaks," and the rods are then placed on end in the open air, being rested against a support of wire fencing. The intensity of colour produced increases with the length of time of exposure and its rate of change varies with the light conditions. As it is necessary that individual rods should be of the same shade throughout their lengths and that uniformity of colour should exist in all the rods from the same and subsequent boilings, their management at this stage should be in the hands of an experienced man. Drying is completed by placing the rods on shelves in a suitable room. Attacks by moulds, which cause

permanent discolorations and hence impaired value, are thus prevented. Grading, according to length, is done either immediately after removal from the boilers or after the rods have become dry. The rods are afterwards tied in bundles, and packed in a store room, and are then ready for sale.

"White rods" are prepared in the spring after the flow of sap has become active and before permanent additions have been made to the wood by secondary thickening processes. Cell activity commences in the region of the apexes of the shoots and travels downwards. Consequently a rod may be "peelable" in its upper portion, while at the butt the rind is still firmly attached to the wood. A backward spring, suddenly followed by a few fine warm days, causes rapid sap-flow, which is closely followed by rapid development of new wood. Under such conditions satisfactory peeling may not be possible for longer than three or four days. Under opposite conditions the peeling period for a variety may last for 12 days.

The brown ragged shreds sometimes seen at the butt ends of white rods indicate that peeling was premature, while the presence of similar shreds on their upper parts shows that the best peeling conditions had passed at the time when the process was carried out.

The peeling period may be prolonged by:—

1. *Growing* several varieties which attain in succession the best peeling conditions.
2. *Couching*, which consists in placing the bundled spring-cut rods in definite order, forming heaps.
3. *Pieing*, in which the bundles are placed on the ground one layer thick, heating being prevented by repeated waterings and turnings.
4. *Pitting*, in which the rods—cut in March—are bundled and placed on end in ditches or in specially constructed pits through which water is induced to flow. Root, flower and leaf development take place, but secondary thickening is slow so that peeling may be continued until July.

The rods are peeled by hand assisted by the "break," female and young labour being employed for the purpose. Attempts have been made in the past to facilitate this operation by devising labour-saving machinery, but without success. A satisfactory decorticating machine is greatly needed. The freshly-peeled rods are dried in the open air by resting them against stretched wire, and afterwards graded according to length, bundled and stored in a dry place.

The rods which have been neither "buffed" nor "whitened" are known as "brown." This class includes rods of inferior growth, and consequently the value of such material is low. Large quantities are accumulated by some growers, much being ultimately wasted, while others manage to sell all their "brown" every year. It is used in the making of the lowest grades of basket-ware, such as vegetable baskets, potato hampers, crates, and scuttles.

Good rods always find a ready market, and the difficulty of selling increases with the poorness in quality. It frequently suits a grower to clear all his stocks annually, so as to save labour, to avoid accumulation and waste, and to make room for the next crop. In such cases close grading is purposely not practised. Manufacturers, on the other hand, prefer to buy material which is of the same size and quality throughout the bulk. The different branches of the basket-making trade are becoming so specialised that a maker can find little or no use for rods which are unsuitable in the making of his class of goods. The price he offers for ungraded rods and mixed willows is low, because the amount of suitable material present may fall short of his anticipated requirements, and expenses would be incurred in the sorting, packing, storing and marketing of the rods which he does not require. Grading according to length is not sufficient. Quality should be taken into account, and the basket-makers' requirements would be more fully met if this were more frequently done.

There are no established markets for willows in this country. The buying is in the hands of merchants and manufacturers, who regularly visit the willow-growing centres towards the end of the growing period to judge the value of the crop when standing and to purchase any dry material which the growers may have in stock. Frequently sales are effected by the forwarding of samples. At the Midland Agricultural College a list of the names of growers, merchants, and manufacturers in the area has been found useful. Growers are supplied with the names of buyers to whom samples and descriptions may be sent, and the latter are informed where the material they require is likely to be obtained. Sewage-farm-grown willows are often advertised for sale by tender, the buyer sometimes being required to cut and remove the crop. Provided such crops are well grown there seems to be no difficulty in finding a market by these means.

Basket-making.—Profitable willow-growing largely depends upon the existence of a flourishing basket-making industry. Until

the latter half of the last century the industry in this country was largely confined to villages and small country towns, and a miscellaneous class of basket ware was produced. The large importations of foreign-made wicker furniture, which could be bought at prices within the range of purchase of the majority of English households, resulted in these articles becoming common. The wealthier members of the community who could afford to purchase the similar but better-made and higher-priced English-made goods at once ceased to require them, and a depression in this branch of the trade followed. It was found to be impossible for the small English manufacturer to compete successfully with the foreign manufacturer in the making of articles of the same quality. The low price at which foreign-made goods can be sold is largely due to the specialisation of firms in the production of one class of articles and to the skill shown in organising the labour employed. The making of an article proceeds in parts, each of which is always dealt with by one set of workmen, who, from long practice, become highly efficient in their work. The result of this specialisation and division of labour is that craftsmen can earn good wages, manufacturers make satisfactory profits, and the public can be supplied with articles at convenient prices. Further, as the public taste is changeable, isolated workers are not placed favourably for coping successfully with variable trade conditions.

A few shillings will provide a basket-maker with all the tools which he requires in the pursuance of his craft, so that lack of capital seldom prevents a journeyman from starting independently in business. The multiplicity of small independent firms has led to local competition, which has ultimately killed the trade in certain centres. Had production been carried out on the lines of united effort, the advantages possessed by the foreign manufacturer would have been counteracted.

The large basket-manufacturing firms which exist have been built up from small ones by the intelligence and trade enterprise of their heads. The employees are paid on the piece-work system, the price paid for the making of any article being fixed in many cases by agreement between the employers and the Basket-Makers Trades Union.

In considering schemes for the establishing of Basket-making as a rural industry, it should be understood that the craft demands great skill on the part of its workers. Many years of training are necessary before a workman of average ability can make a high-class article satisfactorily, and a natural aptitude for the work is possessed by the person who becomes a first-class crafts-

man. Even in the making of some of the coarser kinds of basket-ware, under the present system of working long practice is required before a workman can make such articles well, and at the same time earn satisfactory wages.

Basket-making firms situated in willow-growing areas could immediately provide employment to many discharged soldiers. The number could be increased with an increase of suitable orders which the firms might receive. The rise in wages would be very rapid if a sufficient amount of suitable work for these men were obtained. During the past year many cases have occurred in which men not possessing any previous experience of basket-making have been able to make completely certain kinds of Army ammunition baskets after having had a little instruction and a few days' experience, and within a month of commencing such work have earned from £2 to £3 weekly.

Army ammunition baskets in willow are now accepted by the War Office, and small rural manufacturers should apply for orders for such articles; much employment might thus be found for ex-soldiers at remunerative wages. Societies, such as "The Incorporated Soldiers' and Sailors' Help Society" and "The National Association for the Employment of ex-Soldiers" might be induced to establish basket-making works in the villages of the willow-growing districts for the manufacture of Army baskets, and a portion of the funds collected by public subscription in 1914-15 for the assistance of soldiers and their dependants might be used in the same way. Work of this character would give sufficient initial training in the manipulation of rods to enable the workers to continue in the trade at the conclusion of the war.

There is a great annual demand for various kinds of fruit and vegetable baskets in Kent, Worcestershire, and other areas. Merchants and salesmen place orders for them in quantities of thousands at a time. The English maker, even if he could secure an order suitable to the size of his business, could not profitably execute it at the price offered. The majority of these baskets are of foreign make, the business being carried on as a home industry (the members of the family assisting in the making) in a number of villages forming a centre for this class of work. The baskets are purchased by merchants who supply the English markets. Similar methods of production should be adopted in this country if attempts be made to secure this branch of trade. Covent Garden salesmen and others would place orders for baskets direct if the basket-making colonies were sufficiently large to cope with their requirements.

The Nottinghamshire County Council, at the request of a small colony of fruit-growers in the county, recently arranged to supply them with an instructor in fruit-basket making. These growers hope to be able to employ the time during the winter months in making baskets for their own use. Many willows are grown in the neighbourhood, so that a flourishing industry is likely to spring up, able to supply the local demands and to find more distant markets.

A scheme of organisation of basket-making as a rural industry should have in view the linking up of rural workers with large basket-making firms. The latter might be relied upon to assist in the movement by supplying orders for baskets easy of construction, or for the simpler parts of articles which could be completed afterwards by their more skilled workmen. Hosiery manufacturers in some of the large towns of the Midlands employ the labour in the surrounding villages in a similar way.

Where willows are grown on sewage farms it might be possible to induce the local district councils to employ labour in converting the rods into manufactured goods.

If sufficient publicity be given to the subject, capitalists may be forthcoming who would be prepared to found and maintain basket-making establishments, which under proper management might become, in course of time, profitable undertakings.

Firms and Government Departments giving large orders might encourage this industry by giving preference to willow as the working material in cases where its substitution for cane could be accepted.

There are certain branches of the industry suitable to the natural capabilities of female workers. Women excel in the making of the lighter classes of basket-ware, such as casings for bottles, work-baskets, small tables and chairs, and the various kinds of fancy baskets. The upholstery departments of some firms are largely dependent on female labour.

Financial Considerations.—The financial considerations arising out of willow cultivation are set forth in the publication issued by the Board.[2] Some commercial growers, however, consider that the figures for yield and price therein given are too high for an average year on average land. It may be remarked that in the Somersetshire area the rent of willow-growing land is generally between £4 and £5 per acre, and little can be obtained at a lower price. Much of the land in the Trent basin is rented at the same amount. Regarding the profits following good methods of cultivation, Scaling's views express the opinion of the majority of growers at the present

time: "The value of willow crops will range from £10 to £20 per acre according to the state of trade, and the seasons. Occasionally they are worth more than twice that amount. But I should not advise anyone about to plant to base their calculations on extreme profits, lest disappointment ensue. A good return for the outlay may be relied upon in the average of years, and few, if any, crops will give better results."

Weeds, Pests, etc.—The willow crop is subject to damage by weeds, insect and fungus attacks and unfavourable weather conditions. Insects and fungi cannot be dealt with here. Willow lands grow *weeds* profusely owing to the many weed seeds deposited during flood times and the damp conditions favouring their germination. All grasses are harmful, especially when closely intergrown between the heads, owing to the check which they give to the young shoots during the early stages of growth and the general exhaustive effect which they have upon the land. If allowed to remain until cutting time, grass hinders the operations of the cutters, and much of it is conveyed from the ground in the bundles to be an inconvenience during the later stages of preparation of the rods. As "Green" the presence of dead grass in the bundles detracts from their value. More willow beds have become derelict owing to having become overgrown with *Couch* than to any other cause. When once established this weed grass cannot afterwards be completely eradicated owing to the damage done to the stocks of the willows in the cleaning processes. The weed can be kept in check only by the employment of good methods of cultivation. In 1914 a 10-acre bed, planted on the square, containing much couch, was greatly improved by ploughing between the rows in the two directions. The sods were afterwards broken by hand implements and allowed to remain on the ground until dead. This is a new practice. The work was carried out by a careful ploughman, and no harm to the succeeding crop resulted.

Bindweed sometimes grows luxuriantly. By its habit it draws the rods together, thus preventing free growth. The bends induced become permanent, and the rods are then less valuable. It cannot be eradicated, but its effect can be checked by frequent hand weeding.

Cleavers and Nettles by their irritating action cause a roughness to the parts of the rods (usually the basal portions) with which they come in contact. These pimple-like markings are permanent. The weeds can be removed by means of hand implements.

Burnet frequently occurs in pastures in large amount. Its root is thick and long and much weathering is required to kill it. Grass land in which much burnet is present should be well fallowed before being planted. Its harmful effects are due to the overshadowing of the young shoots and impoverishment of the ground.

Rushes sometimes rapidly develop where conditions favour their growth, but improved drainage and surface cultivation will keep them in check.

Adverse Weather Conditions often cause Damage.—Young shoots are very susceptible to attack by late spring frosts. Slight attacks cause a drooping of the tips of the shoots which never afterwards straighten. At cutting time the effect is shown by the presence of double bends in the rods at places a few inches from their bases. In severe cases of attack the growing points are killed and lateral shoots develop from dormant buds situated lower down the stem. A crop of "rough rods" is the result. A case is known where the young shoots were cut off close to the stocks after a severe frost attack. The crop following was of fine quality, but the yield was below the average. Hail storms sometimes bruise the growing rods, and strong winds may loosen the stools.

Economic By-products.—At present the basket-willow yields no by-products which are used economically in this country. The peelings, often accumulated in large quantities, are ultimately returned to the land. Some horticulturists consider them to be valuable in glass-house cultivation as a bottom layer. The bark of the willow is used for tanning purposes in some northern European countries, and results obtained by American investigators show that tannin was present in basket-willow bark in amounts between 6·4 per cent. and 11·38 per cent. according to the variety tested.[4] It is claimed that these amounts are sufficient to make the bark valuable in the leather industry, but it is not stated in the report on the subject that the bark finds a use in this respect. A sample of bark of *Salix triandra* was reported upon by Messrs. Turney Brothers, tanners, Nottingham, as follows:—"It contains only 4·6 per cent. of tanning matters absorbed by hide, and 5·06 per cent. of soluble non-tanning matters. We believe, however, that the tannin has been destroyed almost entirely by mould, as the bark has been exposed to the weather." In this country it has been tested as a material for paper-making and for the making of a leather substitute without success.

It is claimed to have a value in France as fodder, litter, and as mat and sack-making material.[4]

The salicin in willow bark differs in quantity in the different varieties and varies in amount in any variety throughout the year. It is present in maximum amount during the winter months, and rapidly diminishes in quantity when spring growth becomes vigorous. It is valuable medicinally on account of its antipyretic and other properties, and was largely so used until superseded by the synthetically prepared and much cheaper compound—sodium salicylate. The bark of *S. alba* is largely used. Owing to the high price of salicylate of soda, and the interruption in the securing of salicin from the usual sources of supply the question of its profitable extraction from English-grown willows has been considered, and co-operative experiments on the subject between manufacturing chemists, willow-growers, and the Midland Agricultural College are now in progress.

REFERENCES.

1. *Annual Statement of Trade*, 1914, Board of Trade.
2. *The Cultivation of Osiers and Willows*, Board of Agriculture and Fisheries.
3. *On the Growth and Cultivation of Willows in Scotland*, Edinburgh University.
4. United States Department of Agriculture—Forest Service—Circ. 148. 1908.
5. United States Farmers' Bulletin, 341. 1908.

THE COMPOSITION AND USE OF CERTAIN SEAWEEDS.*

JAMES HENDRICK, B.Sc., F.I.C.,

Professor of Agriculture, University of Aberdeen.

SEAWEEDS differ from our ordinary land plants in that they are rich in ash, and that the great part of the ash consists of soluble salts of potash and soda. They also contain a small quantity of compounds of iodine, which, in certain species, form a very appreciable proportion of the ash. Kelp, or the ash of seaweed, has long been prepared round our coasts, especially in the poor crofting districts of the West Coast and Islands of Scotland and Ireland. This industry at one time brought large sums of money to the Outer Hebrides, Orkneys and Shetlands, and even in recent times a considerable quantity of kelp has been prepared in certain districts. The industry, however, has always been a badly organised one in the hands of small individual producers who are also crofters and

* [illegible]

fishermen. It has consequently suffered many changes and vicissitudes, and, being unable readily to adapt itself to new conditions, has been little able to contend against the highly capitalised modern industries with which it has come into competition.

The chief products which have been obtained from kelp for many years past have been iodine and potash salts. Kelp, therefore, came into competition with iodine from the Chilian nitrate mines and with potash from the German mines. At present, owing to the war, the supplies of German potash compounds are cut off, and the price of potash has risen enormously. Potash is of importance not merely to agriculture but to various industries, including some of those which supply war materials. There has, therefore, been a revival of interest in the kelp industry, as an industry from which supplies of potash are, to a small extent, being obtained in our own country, and from which greatly increased supplies might be obtained.

The amount of information available as to the composition of different seaweeds and different parts of seaweeds; as to the variation in composition with age, season, locality, etc.; as to the quantities of different seaweeds which can be obtained from given areas; as to the rapidity with which seaweed will grow again if it is harvested; as to the costs of harvesting seaweed and transporting it to suitable centres; and, indeed, all such information as should be obtained before a well-organised industry could be based on seaweed, is very limited indeed. Even such matters as the nomenclature, structure, and physiology of common seaweeds do not seem to be settled with certainty. There appears to be a great field for research on all such subjects.

A good many years ago the writer made a few experiments on the use of seaweeds as manure, and, at the same time, made a number of analyses of seaweed.* After the outbreak of war, when interest again began to be taken in the possibility of utilising these plants for industrial purposes on a large scale, the writer returned to the subject with the help of a grant from the Board of Agriculture for Scotland, under the auspices of which his recent enquiries have been carried out. Two things have been kept in view in such investigations as have been made:—

(1) The possibility of temporary measures to increase the potash supply during the war; and

* The Use and Value of Seaweed as Manure; Trans. Highland and Agricultural Society of Scotland, 5th Series, Vol. X., 1898.

(2) The possibility of improving and extending a permanent industry based on seaweed.

It is interesting to note that for some years back investigations have been conducted in the United States, partly by firms and private individuals, partly by the University of California, and partly by the Department of Agriculture, with the object of obtaining all the information which might be of use, directly or indirectly, in the foundation of industries designed to obtain potash and other useful compounds from the seaweeds of the Pacific Coast, which are known in America as Giant Kelps. The main object is to render the United States independent of supplies of German potash salts. Long before the outbreak of war cut off supplies of German products the Americans set out to try and find such supplies of potash in their own territories as would make them independent of Germany. This wise desire has naturally been intensified by the events of the past year. Though we have had a seaweed industry of a kind in this country for generations, nothing has been done which compares in completeness, manysidedness, and breadth of view with the enquiries into the seaweeds of the Pacific Coast and their utilisation, which are, at present, being conducted in America.

The seaweeds, which are found growing round our coasts in sufficient abundance to be of importance from the point of view of potash supply, belong to two different families :—

(1) Seaweeds which grow between tide-marks, and are commonly known by such names as "black wrack," "cut weed," and "bladder wrack." These belong to the genus *Fucus*, of the Natural Order *Fucaceæ*.

(2) Seaweeds which grow in comparatively shallow water, below low-water mark, and are commonly known by the names "drift weed," and "tangles." These belong to the genus *Laminaria*, of the Natural Order *Laminariaceæ*.

At different periods kelp has been made from seaweed of both these families. In early times, when kelp was made chiefly for its alkali, *Fuci* were largely used. Later, when it was produced as a source of iodine and potash, *Fuci* passed out of use, and kelp was made only from *Laminariæ*. The reason for this change will be made quite apparent by a study of Tables I. to VII.

Seaweeds of both families in the fresh state, but free from adherent moisture, contain 70 to 85 per cent. of moisture. Some of the samples yielding the analyses shown in the tables

had become partly dried while being transported to the laboratory from remote parts of the West Coast and therefore show low percentages of moisture. Seaweeds contain a large proportion of ash, the great part of which consists of salts of potash and soda. The ash, roughly speaking, forms 20 to 25 per cent. of the dry matter. In the case of the stems of *Laminaria* (tangles) it ordinarily forms 30 per cent. or more, but the proportion is not so high in the fronds. In some of the Giant Kelps of the Pacific Coast the proportion of ash found is even higher than in the stems of *Laminaria.*

TABLE I.—*Composition of Laminaria digitata.*

—	Maximum.		Minimum.		Average.	
	Stems.	Fronds.	Stems.	Fronds.	Stems, 10 samples.	Fronds, 8 samples.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Water	84·56	84·68	75·50	56·88	82·37	74·75
*Organic Matter	16·31	32·66	8·62	9·81	12·31	19·59
Ash Soluble in Water ..	6·78	7·41	3·56	2·64	4·92	4·26
Ash Insoluble in Water, *but Soluble in dil. H Cl.*	1·94	2·63	0·78	0·68	1·29	1·17
Siliceous Matter ..	0·33	0·42	0·02	0·02	0·12	0·22
**Containing Nitrogen*	*0·28*	*0·59*	*0·15*	*0·20*	*0·23*	*0·34*
In Soluble Ash :—						
Potash	2·92	2·51	1·18	0·65	1·83	1·28
Soda	2·95	1·59	0·62	0·36	1·12	1·04
Sulphuric Anhydride ..	0·95	1·46	0·37	0·49	0·52	0·76
Total Halogen as Chlorine	2·52	2·54	0·65	0·68	1·73	1·43
Iodine	0·131	0·170	0·072	0·043	0·095	0·095

During the past year a large number of analyses have been made in the writer's laboratory of samples of the common seaweeds collected from different points on the coast of Scotland, nearly the whole of the samples being obtained from the Western Islands and from the Orkneys. The samples were obtained at different times of year, one set of samples being collected in winter, a second in spring, and a third in summer. A summary of these analyses is given in Tables I. to VII. showing :—(1) The composition of the weeds as obtained; (2) The composition of their dry matter; (3) The maximum, minimum and average figures found for each kind of seaweed and for each determination made; and (4) Some of the more important figures as to the composition of the ash of the seaweeds.

Of the different species of *Laminariæ*, *L. digitata* is by far the most important. Next to it in importance comes *L. stenophylla,* which is classed by some not as a separate species, but as a variety of *L. digitata.* As there is some uncertainty as to the nomenclature of different species of *Laminariæ,* it may be said that the name *L. digitata* as here used refers to

the variety figured as *L. digitata* (Lamour) in Harvey's Phycologica Britannica, 1871, plate CCXXIII; and where the name *L. stenophylla* is used it refers to plants more or less closely corresponding to that figured as *L. digitata* (var. *stenophylla*) in Harvey's Phycologica Britannica, plate CCCXXXVIII. All the *Laminariæ* consist of a stem (stipes) and a broad, flat frond or lamina. In the case of the two important species, stems and fronds have been analysed separately, and separate analyses are given for them in Tables I. to IV.

TABLE II.—*Composition of Dry Matter of Laminaria digitata.*

	Maximum.		Minimum.		Average.	
	Stems.	Fronds.	Stems.	Fronds.	Stems, 10 samples.	Fronds, 8 samples.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
*Organic Matter	70·59	86·84	55·81	62·08	64·03	77·28
Ash Soluble in Water ..	30·54	30·96	21·92	12·23	27·98	17·30
Ash Insoluble in Water, but Soluble in dil. H Cl.	11·48	9·32	4·72	2·85	7·37	4·59
Siliceous Matter ..	2·17	1·78	0·11	0·05	0·66	0·82
*Containing Nitrogen	1·64	1·72	0·93	0·77	1·31	1·30
In Soluble Ash:—						
Potash	12·67	9·40	7·00	2·26	10·49	5·25
Soda	7·73	7·86	3·80	1·09	5·35	4·24
Sulphuric Anhydride..	5·49	6·10	2·21	1·89	2·94	2·97
Total Halogen as Chlorine	12·20	12·51	3·87	2·38	9·92	6·11
Iodine	0·649	0·482	0·455	0·280	0·536	0·376

The tangles, which are washed ashore in great quantities in winter, and from which the variety of kelp known as "tangle ash" is made, consist of the stems of *Laminariæ*, and, so far as the writer's observation goes, are composed almost entirely of stems of *L. digitata*. The "May-weed" or "drift-weed," which is cast ashore in immense quantities in spring, consists, on the other hand, very largely of the fronds, which break off naturally at that season. With these are always mixed some stems as well as portions of seaweeds of various other species, but they form only a small part of the whole. From this weed, ordinary kelp is made.

Tables I. and III. show that the stems contain more moisture than the fronds. Nevertheless, they contain more ash and potash than the fronds, and their deficiency in dry matter as compared with the fronds is due to their much lower percentage of combustible organic matter. The stems and the fronds contain, on the average, about equal quantities of iodine.

If we consider merely the dry matter, Tables II. and IV., it will be seen that the superiority in potash of the stems is brought out even more markedly. On the average, the dry

stems contain 10 or 12 per cent. of potash, while dry fronds contain only about 5 per cent. Certain of the Giant Kelps of the Pacific Coast have been found to yield very high percentages of potash in their dry matter. Of our common seaweeds, the stems of *Laminaria* (tangles) appear to be the only ones which approach them in this respect. If tangles were merely dried and ground they would form a manure containing about 10 per cent. of potash, together with about 1 per cent. of nitrogen, and a considerable amount of organic matter. At the present price of potash such a manure would be very valuable, and even in ordinary times it might be worth consideration as a constituent of manure mixtures.

TABLE III.—*Composition of Laminaria stenophylla.*

—	Maximum.		Minimum.		Average.	
	Stems.	Fronds.	Stems.	Fronds.	Stems, 4 samples.	Fronds, 4 samples.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Water	83·26	81·41	80·50	78·05	83·44	79·55
*Organic Matter	13·35	17·64	9·18	13·83	11·04	15·79
Ash Soluble in Water ..	4·83	4·18	4·40	3·43	4·65	3·74
Ash Insoluble in Water, but Soluble in dil. HCl.	1·45	0·88	0·70	0·81	1·02	0·86
Siliceous Matter ..	0·30	0·17	0·01	0·02	0·11	0·06
*Containing Nitrogen ..	0·25	0·27	0·14	0·17	0·18	0·23
In Soluble Ash,—						
Potash	2·18	1·15	1·68	0·85	1·94	1·01
Soda	0·88	1·10	0·62	0·84	0·75	1·01
Sulphuric Anhydride..	0·37	0·56	0·26	0·33	0·30	0·48
Total Halogen as Chlorine	1·93	1·57	1·60	1·21	1·79	1·41
Iodine	*0·098*	*0·066*	*0·036*	*0·050*	*0·059*	*0·058*

It was found that the samples of *Laminaria digitata* which were collected in the spring and summer were richer in potash than the winter samples. The number of samples analysed, however, was too small for one to base any general conclusions on them. This is a point which deserves further attention, for, at present, tangles are collected mainly in winter.

Table VII. shows the percentages of potash and iodine in the ash of the different seaweeds, and also the proportion of iodine in the ash expressed as pounds per ton. The ash of *Laminariæ* stems is very rich in potash. The minimum in 14 samples analysed was over 20 per cent., and the average about 29 per cent. Even in the fronds, the minimum was about 17 per cent., and the average over 20 per cent. At the present price of potash such ashes would be very valuable even if the iodine were neglected altogether. Potash is, at present, quoted at about 15s. per unit, so that an ash containing 20 per cent. of potash should be worth about £15 per ton for its potash alone. The potash found in the ash of seaweeds is all soluble in water,

and is present almost entirely as a mixture of chloride and sulphate.

TABLE IV.—*Composition of Dry Matter of Laminaria stenophylla.*

—	Maximum.		Minimum.		Average.	
	Stems.	Fronds.	Stems.	Fronds.	Stems, 4 samples.	Fronds, 4 samples.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
*Organic Matter	68·45	80·58	61·15	74·38	64·73	77·76
Ash Soluble in Water ..	33·57	21·05	22·57	15·46	29·00	17·84
Ash Insoluble in Water, but Soluble in dil. HCl.	7·42	4·38	4·67	3·87	5·73	4·13
Siliceous Matter ..	1·56	0·84	0·04	0·08	0·53	0·26
*Containing Nitrogen ..	1·26	1·46	0·86	0·75	1·02	1·08
In Soluble Ash:—						
Potash	15·16	5·47	8·55	3·74	12·35	4·49
Soda	6·64	5·70	3·17	4·54	4·91	4·91
Sulphuric Anhydride..	1·91	2·67	1·59	1·69	1·77	2·42
Total Halogen as Chlorine	13·43	7·96	8·21	5·48	11·28	6·56
Iodine	0·501	0·330	0·233	0·236	0·319	0·289

The ash of *Laminariæ* also contains notable quantities of iodine. In this respect it is much more valuable than that from the Giant Kelps of the Pacific Coast which, though very rich in potash, are poor in iodine. The iodine usually amounts to about 0·1 per cent. of the original *Laminaria*, or to about 1 to 2 per cent. of the ash. On the average, the ash of the fronds is rather richer in iodine than the ash of the stems. The iodine is present in the ash in the form of iodides. In the original tissues it is present, to a large extent at any rate, in organic combination. On the average, *L. digitata* is richer in iodine than *L. stenophylla*, both as regards the stems and the fronds. The average amount of iodine in the ash of *L. digitata* was over 33 lb. per ton in the stems, and over 40 lb. per ton in the fronds, and it rose as high as 61 lb. per ton in one case.

Figures as high as these are never obtained in commercial samples of kelp. As a rule, commercial kelp is very impure, and is much lower in both potash and iodine than it should be if it were carefully prepared from clean weed and preserved from deterioration and loss. The ash of *Laminariæ*, and especially of the stems of these seaweeds, is so rich in both potash and iodine that it offers good prospects for the foundation of a permanent industry. An ash containing 20 to 30 per cent. of potash, and 30 to 40 lb. of iodine per ton, should be sufficiently valuable to be worth attention, even when peace returns and the price of potash falls to a normal level. If these seaweeds were collected and dried, and then either burnt or otherwise treated for the preparation of valuable

—	Maximum.			Minimum.			Average.		
	F. vesiculosus.	*F. nodosus.*	*F. serratus.*	*F. vesiculosus.*	*F. nodosus.*	*F. serratus.*	*F. vesiculosus,* 5 samples.	*F. nodosus,* 6 samples.	*F. serratus,* 4 samples.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Water	74·15	77·07	78·89	60·40	66·23	71·34	68·17	70·52	75·40
*Organic Matter	30·54	25·75	22·02	21·19	17·41	15·74	25·29	23·13	19·08
Ash Soluble in Water	7·68	5·73	4·75	3·78	4·42	3·83	5·19	4·94	4·22
Ash Insoluble in Water, but Soluble in dil. HCl. ..	1·93	2·16	1·47	0·55	0·76	0·96	1·06	1·24	1·12
Siliceous Matter	0·39	0·38	0·42	0·07	0·03	0·03	0·28	0·17	0·16
*Containing Nitrogen	0·61	0·39	0·46	0·25	0·27	0·31	0·38	0·33	0·36
In Soluble Ash :—									
Potash	1·23	0·95	1·12	0·71	0·53	0·86	0·97	0·78	1·02
Soda	2·03	2·03	1·25	1·21	1·32	1·12	1·45	1·68	1·18
Sulphuric Anhydride	2·86	1·91	1·14	1·37	1·34	0·91	1·85	1·64	0·97
Total Halogen as Chlorine	1·65	1·23	1·27	0·55	0·83	0·98	1·11	1·01	1·13
Iodine	0·026	0·067	0·019	0·004	0·012	0·008	0·013	0·026	0·012

TABLE VI.—*Composition of Dry Matter of Chief Varieties of Fucus.*

—	Maximum.			Minimum.			Average.		
	F. vesiculosus.	*F. nodosus.*	*F. serratus.*	*F. vesiculosus.*	*F. nodosus.*	*F. serratus.*	*F. vesiculosus,* 5 samples.	*F. nodosus,* 6 samples.	*F. serratus,* 4 samples.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
*Organic Matter	81·94	80·16	80·52	77·14	73·88	74·54	79·71	78·39	77·56
Ash Soluble in Water	19·37	20·37	20·39	14·65	14·95	15·28	16·08	16·90	17·30
Ash Insoluble in Water, but Soluble in dil. HCl. ..	5·84	6·41	5·13	2·15	2·71	3·84	3·30	4·14	4·53
Siliceous Matter	1·30	1·34	1·48	0·22	0·12	0·16	0·92	0·57	0·62
*Containing Nitrogen	1·54	1.66	2·18	0·80	0·89	1·22	1·18	1·13	1·50
In Soluble Ash :—									
Potash	3·76	3·01	5·28	2·31	1·27	3·43	3·07	2·52	4·18
Soda	5·09	7·19	5·78	3·97	4·38	4·40	4·51	5·78	4·85
Sulphuric Anhydride	7·21	5·83	4·27	4·53	5·15	3·63	5·71	5·46	3·95
Total Halogen as Chlorine	5.02	5·32	6·01	2·11	2·92	3·40	3·44	3·50	4·70
[illegible]	[illegible]	[illegible]	[illegible]	0.013	0·052	0·032	0·040	0·088	0·049

TABLE VII.—*Composition of Ash of Seaweed.*

—	Maximum.		Minimum.		Average.	
	Stems.	Fronds.	Stems.	Fronds.	Stems, 10 samples.	Fronds, 8 samples.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Laminaria digitata :—						
Ash in Weed as received	8·19	10·46	4·78	3·75	6·32	5·66
Potash in Ash	35·62	26·35	20·10	16·80	28·71	20·99
Potash as K_2SO_4	65·86	48·75	37·21	31·10	53·13	54·84
Iodine in Ash	1·810	2·729	1·056	0·762	1·40	1·828
Lb. Iodine per ton	41·64	61·13	23·65	17·07	33·84	40·91
Laminaria stenophylla :—						
Ash in Weed as received	6·15	5·22	5·56	4·31	5·78	4·66
Potash in Ash	39·21	22·03	27·07	17·47	33·60	20·21
Potash as K_2SO_4	73·43	40·76	50·06	32·32	62·38	37·58
Iodine in Ash	1·581	1·577	0·647	0·958	0·995	1·285
Lb. Iodine per ton	35·50	35·33	14·49	21·46	22·31	28·78

	Maximum.			Minimum.			Average.		
	F. vesiculosus.	*F. nodosus.*	*F. serratus.*	*F. vesiculosus.*	*F. nodosus.*	*F. serratus.*	*F. vesiculosus.*	*F. nodosus.*	*F. serratus.*
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Fucus :—									
Ash in Weed as received	9·06	8.02	6·64	4·66	5·52	4·88	6·53	6·35	5·49
Potash in Ash	20·82	14·88	20·76	12·35	9·47	16·71	15·29	12·22	18·60
Potash as K_2SO_4	38·54	27·54	38·39	22·86	17·53	30·93	28·31	22·61	34·40
Iodine in Ash	0·558	1·159	0·286	0·069	0·217	0·160	0·225	0·415	0·213
Lb. Iodine per ton	12·50	25·96	6·41	1·55	4·86	3·67	4·59	9·29	4·77

products, under better conditions, with better plant and more efficient organisation than at present, there seems every reason to hope that a permanent and profitable industry might be developed.

The *Fuci* are not nearly so rich in potash and iodine as the *Laminariæ*. Whereas the *Laminariæ*, generally speaking, contain a higher percentage of potash than of soda, and in the ash a higher percentage of halogens than of sulphuric anhydride, the *Fuci* are, as shown in Tables V. and VI., richer in soda than in potash, and their ash usually contains more sulphuric anhydride than halogens—compared with the *Laminariæ* they are very poor in iodine. These differences explain why, when kelp was no longer used as a source of alkali, but became important for its iodine and potash salts, the use of *Fuci* was given up.

In the dried state *Fuci* do not yield nearly so rich a manure as *Laminariæ*. The analyses in Table VI. show that, on the average, they contain only 3 or 4 per cent. of potash when dry, and the maximum found was only 5½ per cent. in a sample of *Fucus serratus*. The different species were found to vary fairly considerably, *F. nodosus* being poorest in potash and richest in soda, while *F. serratus* was richest in potash. It does not seem likely that it would be remunerative, even at the present price of potash, to dry and grind *Fuci* for manure. In nitrogen they are about equal to the *Laminariæ*.

The important constituents of the ash of *Fuci* are shown in Table VII. On the average, the ash of even *F. nodosus* contains over 12 per cent. of potash, while the minima for *F. vesiculosus* and *F. serratus* are over 12 per cent. It may be taken, therefore, that well-prepared ash made of mixed species of *Fuci* will contain over 12 per cent. of potash, and generally considerably over 12 per cent. It will, therefore, be as rich as, or richer than, the well-known potash manure kainit in this constituent. So long as potash continues at its present price it would probably pay well to dry and burn *Fuci* in order to obtain potash manure. These seaweeds can be obtained in quantity from many parts of the coast, including many sheltered waters from which no great quantities of *Laminariæ* can be conveniently obtained. They can be gathered or cut from the rocks at low tide, whereas *Laminariæ* must be washed ashore by tides and storms, or be cut and gathered from a boat. They can be comparatively easily dried to a sufficient extent to be burned. They do not require complete drying, for once a fire is started its heat completes the drying, and, at the same time, the addition of incompletely dried

weed keeps down the temperature of the fire, which should not be allowed to get too high.

TABLE VIII.—*Analyses of Kelp from Hebrides.*

—	Tangle Ash.		Kelp.			
	Good Quality.		Good Quality.		Poor Quality.	
	1.	2.	1.	2.	1.	2.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Mineral Matter Soluble in Water ..	61·99	55·26	59·54	57·04	20·70	31·25
Mineral Matter Insoluble in Water but Soluble in dilute HCl.	16·97	19·43	28·78	23·06	29·94	29·59
Siliceous Matter	11·67	12·90	6·97	7·84	27·59	15·53
Soluble in Water:—						
Potash	24·05	20·69	21·96	15·10	5·17	8·51
Soda	10·44	8·90	16·85	13·68	2·55	10·05
Sulphuric Anhydride	4·00	4·19	2·68	10·42	8·11	6·65
Sulphur as Sulphide	0·54	0·61	2·26	0·30	0·25	0·12
Total Halogen as Chlorine ..	19·45	21·80	25·67	20·23	1·60	8·84
Iodine	0·90	1·19	0·55	0·67	0·10	0·30

Great quantities of valuable potash manure could be obtained if only the collection and burning of seaweeds, both *Laminariæ* and *Fuci*, could be organised and carried out on a large scale. The available quantities of material are immense, but enterprise and organisation are needed.

A number of samples of kelp produced by crofters in the Hebrides during the season 1914 were analysed during the course of this enquiry, and some of the results are shown in Table VIII. All these are stated to have been prepared from *Laminariæ*, the "tangle ash" from tangles, *i.e.*, stems of *Laminariæ* gathered in winter, and the kelp from "drift weed" washed ashore in spring and early summer. The table shows that the samples vary greatly in quality, and do not contain so much potash and iodine as the samples of the ash of *Laminariæ* prepared in the laboratory (Table VII.). There are a number of reasons for this: (1) All these samples contain considerable percentages of siliceous matter, whereas laboratory samples were almost free from such impurity Owing to the rough methods employed it is not possible entirely to avoid the inclusion of sandy matter in preparing kelp on the large scale, but the large proportions of sand found in most of the samples are quite unnecessary, and indicate more or less carelessness in preparation. (2) The kelp samples contained a certain proportion of carbon and moisture. Laboratory samples were free from these. Samples of kelp should be nearly dry, and the presence of much moisture indicates exposure to damp through careless handling and improper storage. Unfortunately, the poor people who prepare

kelp are often unable to store it properly. (3) Before the weed is burned it is often exposed to wet weather during drying, and sometimes a large part of its soluble salts are washed away before it is burned into kelp. During the process of drying, the weed should be as little exposed as possible to *leaching by rain water.* (4) *If the heat is too great during* burning, and especially if silica and lime are present, iodine, and to a limited extent, potash, are apt to be volatilised and lost. A part of the potash may also be fused into silicate under such conditions.

Seaweeds are used, to a certain extent, as food for human beings, and in the crofting districts of Scotland and Ireland as food for stock. Dulse (*Rhodymenia palmata*) is used to a small extent as human food or as a relish to food, both in the fresh state and dried, all round the coasts, and not only in the crofting districts, but it is only in the poorer districts that seaweed is used as *food for stock.* When in the west of Lewis the writer had an opportunity of making some observations on the seaweeds which were eaten by stock. Both cattle and sheep came down to the beach at low tide of their own accord and ate seaweed. A number of ewes, accompanied by their lambs, were observed. The ewes all ate two varieties of seaweed only. These were Dulse and *Alaria esculenta.* Some of the ewes appeared to eat Dulse only, others ate both weeds freely, but not one of them was observed to eat any other seaweed but these two. Dulse often grows on *Laminaria* stems. The sheep ate Dulse off the *Laminaria* stems, but did not eat the *Laminaria.* The lambs did not eat any seaweed.

The cattle were observed also to eat two varieties of weed only, namely *Laminaria stenophylla* and *Alaria esculenta.* Though there were heaps of *L. digitata* lying on the shore they merely turned it over with their muzzles till they found a piece of *L. stenophylla* or *Alaria*, which they at once ate. They were not once observed to eat *L. digitata,* though this species and *L. stenophylla* so closely resemble one another. Also, when they ate *L. stenophylla* they ate the frond only.

Some of the crofters were on the beach at lowest tide gathering fresh seaweed from the water into creels. They stated that it was for the cattle. The variety they were gathering was entirely *L. stenophylla,* which they said was very good for the health of the stock. They gathered both stems and fronds.

In Table IX. are given analyses of seaweeds used as food, made by the ordinary methods used for feeding-stuffs. Though

there was plenty of *L. saccharina* on the beach neither cattle nor sheep were seen to eat it, but as it was stated that they eat it also, a sample was analysed. The analysis of Dulse is taken from a paper which the writer published in *The Agricultural Students Gazette,* Vol. VI., p. 129, 1893. This sample was obtained from the neighbourhood of Oban. The other samples, analyses of which are given in Table IX., were gathered from the place where the cattle and sheep were observed eating seaweed in Lewis.

TABLE IX.—*Feeding Stuff Analyses of Seaweeds.*

Kind of Weed.	From West Coast of Lewis.			From Oban.
	Laminaria stenophylla.	*Laminaria saccharina.*	*Alaria esculenta.*	*Rhodymenia palmata* (Dulse).
	Per cent.	Per cent.	Per cent.	Per cent.
Moisture	81·41	85·38	82·06	78·20
Ether Extract (Oil, etc.)	0·21	0·16	0·23	—
Albuminoids (N × 6·25)	1·69	1·32	1·56	4·61
Soluble Carbohydrates, by difference ..	10·74	6·50	10·45	12·01
Fibre	1·19	0·97	1·15	0·61
*Ash	4·76	5·67	4·55	4·57
	100·00	100·00	100·00	100·00
*Containing Siliceous Matter	0·05	0·44	0·07	0·05

SOME METHODS OF ADDING TO OUR FOOD SUPPLIES.

R. G. STAPLEDON, M.A.,

Adviser in Agricultural Botany, University College of Wales, Aberystwyth.

IN their final report the Departmental Committee for England and Wales on the Home Production of Food insisted on the great need of increasing the productivity of the soil in this country. To anybody who has studied the conditions of farming at all closely in the southern half of Wales and in the south-west of England generally it is at once patent that all schemes that aim at increased production should also make for enhanced soil fertility.

It may, therefore, serve a useful purpose to inquire into the more obvious limiting factors which militate against increased productivity, and to show how they might be remedied. The matter brought forward, and the suggestions made, in the present article are based in particular on observations made and upon work done on the considerable areas in North Devon and in Wales which range in elevation from about 350 ft. to 800 ft.; they doubtless apply, however, with equal force to some other localities at even lower elevations. At the altitudes mentioned the

activities of the plough are inconsiderable, and consequently the degree of soil fertility is reflected in, and largely determined by, the condition of the grass land.

The chief causes of the inferior condition of the grass land and the consequent infertility of the soil are, probably:—

1. The passing of the universal practice of liming.
2. Insufficient and improper use of phosphatic manures.
3. The exhausting nature of the rotations in common practice.
4. Lack of appreciation of the real value of clovers.
5. Excessive use of rye grass in seed mixtures.
6. The confining of rotation land to one part of the farm; and the length of the rotation.

Each of these causes is reviewed, in turn, and general recommendations for improvements are made in the summary at the end of this article.

It is, of course, realised that some of the methods of improvement suggested, although desirable, may in many cases not be practicable owing to the difficulties connected with labour and transport during the War. In many instances, however, these difficulties may not be insuperable, and it would be better to adopt measures likely to produce lasting benefit than such as would have only temporary results.

1. **The Passing of the Universal Practice of Liming**, and

2. **Insufficient and Improper Use of Phosphatic Manures.**—There are great numbers of farms in Wales, and in Devonshire and elsewhere in the western counties, which have not received a load of lime for 20 years or more, not, indeed, since the lime kilns along these coasts ceased to work. It is, however, a well-known fact that to obtain good grass land the soil must have a sufficiency of lime and phosphates—the two ingredients which are commonly lacking in the soils of the west and which are so much removed by growing animals. Lime is not prohibitive in price: it is obtainable at most stations in Wales and Devonshire at a price ranging from 10*s.* to 24*s.* per ton. It is interesting to observe that liming is still a fashion peculiar to certain parishes and districts; while in other centres where the agricultural conditions are precisely the same the practice has gone entirely out of use. Moreover, it does not appear that there is usually any particular reason for this, the railway facilities being no better or no worse in the one locality than the other. One reason for the decreased use of lime appears to be the very general belief amongst farmers that basic slag sufficiently takes its place, a belief that cannot be substantiated in the case of soils inherently poor

in lime. Both lime and phosphates are much misused. Where lime is employed it is frequently applied to excess, especially on grass land. There is no justification for this, for on much grass land the bagged limes may be used with equal success, whilst a number of farmers find no trouble in applying quicklime with a manure distributor. The best time to apply lime for the benefit of the grass is, however, in the rotation before the land is put down.

With regard to phosphates, there is no doubt that superphosphate often produces good and quick results on grass land, even on soils where lime is deficient; but such results are not lasting, and by further exhaustion of lime make for ultimate infertility—an infertility that will manifest itself in the form of "finger and toe" in a subsequent root crop. A large number of farmers on these soils use superphosphate to the exclusion of basic slag, and have done so for a decade without resort to as much as a bag of lime. Further, in recent times, there has been a growing tendency amongst these farmers to use sulphate of ammonia instead of nitrate of soda—a tendency which will increase on account of the present shortage of nitrate of soda and the facilities given for obtaining sulphate of ammonia at a reasonable price. The result of this excessive use of superphosphate and growing use of sulphate of ammonia is, of course, to deplete the already inadequate supply of lime in the soil to a degree incompatible with reasonable fertility.

It has been sought to emphasise the fundamental need of lime in the west; the remedy must take the form of awakening the farmer to this need and then bringing the lime as near his door as possible; for it is the cartage that he *considers* prohibitive. The means whereby these difficulties may be overcome are discussed in the summary.

3. **The Exhausting Nature of the Rotations in Common Practice.**—It is a remarkable fact that whereas the husbandry in the west is grass land husbandry, yet the average farmer when arranging his rotation thinks less of the effect of the rotation on his subsequent grass than he does of the other crops that he expects his rotation to yield. This is all the more regrettable when, as likely as not, he will leave his seeds down for from four to eight or even more years. One type of rotation is:—Corn; corn; roots; corn; seeds; that is to say, in four years three corn crops and one root crop, save only the leaves, are removed from the land. If adequate manures are supplied in the rotation a good ley may be obtainable for three to four years, provided the ley itself receives proper attention, but deterioration of the sward cannot long

be postponed. The chance of securing a successful ley would be much enhanced if somewhere in the rotation catch cropping and consequent folding on the ground were resorted to. It would be a gain if, with the first corn crops, broad red clover and a little Italian rye grass were sown; this would provide some valuable autumnal grazing and also husband soil fertility. It would be advantageous, also, to put the seeds for the ultimate ley in with a light sowing of rape instead of with barley or oats. The gain is twofold: (1) the final crop in the rotation is returned to the land for the benefit of the "seeds"; and (2) rape need not be sown until June, so that there is a prolonged chance of obtaining a good and clean* tilth for the "seeds," and of getting them in under the most favourable seasonal conditions. The complete failure of leys at high elevations is frequently due to a foul seed bed and bad weather conditions.

There is now being brought under the plough a certain amount of heath land and of outrun grass, all of which will probably in a few years' time again go down to more or less long-duration grass. It is an unfortunate fact that heath land broken up to yield a few crops and then put down to grass under existing methods, deteriorates very rapidly, becoming completely overrun with bent (*Agrostis vulgaris*), and remains for a number of years of less value than the normal fescue pastures of the heath. It will, indeed, be a tragedy if much land broken up to meet the needs of the present crisis is allowed ultimately to revert to something as bad as, or worse than, the original. To the long-sighted farmer, however, now is a golden opportunity to plough up outrun grass land and heath land; he should not only keep in view the production of corn or other immediately available foodstuffs, but his aim all through the rotation should also be to accumulate fertility for the benefit of his coming grass. Unless this is generally done, the nation will lose rather than gain in proportion to the amount of land so broken.

4. **Lack of Appreciation of the Real Value of Clovers.**—The great majority of farmers in the regions under discussion look upon the clovers merely as a food, desirable food it is true, for stock. Professor Somerville† has convincingly proved the value of clovers as conservers of fertility, and properly understood this is their greatest value. In order to succeed, clovers must have a sufficiency of phosphates and lime, and to husband fertility they need

* That is to say, the farmer has ample opportunities to harrow and get the annual weeds to germinate and then to harrow them out.

† Somerville, W., Accumulated Fertility in Grass Land, *Jour. Board of Agriculture*, Vol. XXI., September, 1914, p. 481.

to be ploughed down while still abundant on a field. In practice these conditions are by no means fulfilled, the leys being broken up when partially or wholly outrun; indeed, they are so treated *because* the clovers have dropped to nothing. An obvious method is to shorten the rotation, and do away with long-duration leys; this, however, spells a return to arable farming proper which, to any extent, will be an after-the-war and not a during-the-war expedient.

The aim of the farmer in the western counties should be to encourage his clovers to persist for a reasonable length of time, and this he may do in several ways, provided always that he uses lime and phosphates. With regard to red clover he should on no account purchase South American seed, but should insist on having seed of English or Welsh growth (grown at as high an elevation as possible). Such seed will often be dull in appearance, may contain rather much rib-grass, but if free from docks and wild carrot should be accepted if it germinates over 90 per cent. A part at least of the red clover included in the mixture should consist of the relatively lasting "Late Flowering Red Clover." The only clover that will really last for six years and upwards, however, is white clover. On many soils, if the ley is properly treated and a phosphatic manure (in the generality of cases basic slag) is applied in the autumn after the covering crop is removed, and again subsequently, white clover will grow naturally and persist in proportion to the proper management of the field. If it is found that, despite an ample use of phosphates and even when commercial white or Dutch clover* is sown, white clover does not come in or persist on a farm, then, expensive as the seed is, resort should be made to the use of Wild White Clover.†

A good development of clovers (especially white clover) early in the life of a ley is the surest way of obtaining a good bottom to, and a prolonged subsequent grazing from, a prepared pasture, for these leguminous herbs add immediately to the fertility of the soil and encourage the meadow grasses, crested dogstail and other valuable and lasting indigenous grasses.

In Wales and in many parts of North Devon above about 500 ft. trefoil is as elsewhere largely sown, but at these altitudes it seldom does well. The plant that actually appears and succeeds

* Failures when commercial Dutch clover are sown are frequently due to the inferior seeds purchased. This seed has become very expensive, and consequently cheap samples contain much old and "hard" seed, and, as well as weed impurities, quantities of trefoil and yellow suckling clover. See p. 1046.

† See article on Wild White Clover, p. 1063.

is not trefoil (*Medicago lupulina*) but the indigenous yellow suckling clover (*Trifolium minus*). The misguided use of trefoil in these districts involves in the aggregate a considerable annual waste of money.

5. **Excessive Use of Rye Grass in the Mixtures.**—The practice of sowing something like a bushel of rye grass, with no other grasses or only a little cocksfoot and timothy, together with clovers, for a long duration ley is still all too prevalent in the west.* Yet this practice, in conjunction with the continual taking of hay for the first two, three or even four years in the life of a ley, is probably responsible for the rapid deterioration of innumerable fields. Matters are worse when the hay is regularly cut too late in the season. Yorkshire fog and even bent (or fiorin) are then allowed to ripen their seeds, which fall to the ground abundantly during harvesting, and year by year produce an accumulative deterioration of the herbage—a deterioration which is the more pronounced since the rye grass falls off rapidly after the second year and leaves little or nothing to compete with the upstart fog and bent.

If they are to be a success, mixtures for long-duration leys should be reinforced with fair quantities of cocksfoot, timothy, and crested dogstail in particular, with a corresponding decrease in the amount of rye grass. If the general practice were to sow never less than 6 lb., and preferably 8 lb., of cocksfoot to the acre and never more than 14 lb., and preferably 10 lb., of rye grass instead of the 1 or 2 lb. of cocksfoot and 18 lb. to 26 lb. of rye grass, the gain in the productivity of the grass land in the regions under review would be both lasting and material.

6. **Confining the Rotation Land to one part of the Farm; and Length of Rotation.**—The rotation practised in districts most essentially devoted to grass land is a long one. The leys are frequently left down from four to six years, and often as long as eight to twelve years. This is an important point when estimating the condition of the grass land in any district, for usually the leys, especially at the higher elevations, deteriorate rapidly after they have been down more than two or three years.

Some light is thrown on this question by figures obtained and observations made by the writer in connection with a botanical survey now in hand of the district behind Aberystwyth. In dealing with the main cultivated tract up to 600 ft. above sea level

* Such a mixture when used on good soils freely manured, especially with phosphates, will sometimes give a good long-duration ley, because under these conditions valuable indigenous grases soon come in naturally; on poor soils, however, this is not the case.

(as opposed to the heath and mountain tracts) it has been found expedient to classify the cultivated land as follows:—(*a*) Cultivated land proper, *e.g.*, land actually under corn or roots, or under well-tended leys (judged by botanical criteria): in practice such leys are in their first or second year, or even in a third or fourth year, if under the influences of good management they retain the impress of cultivation so long; (*b*) Outrun leys, *i.e.*, leys which have largely reverted to a relatively poor and indigenous herbage: in practice these are fields which have been down to grass from three to twelve years; (*c*) Permanent grass proper (judged by botanical criteria): in practice these have been down for 20 years and upwards, and occur in greatest amount at relatively low elevations. The area surveyed is typical of thousands of acres in the west, and hence the following figures showing the acreage under each of the foregoing types are suggestive:—

	Acres.	*Per cent.*
(*a*) Cultivated land, including tended leys	6,315 ..	40·9
(*b*) Outrun leys	5,760 ..	37·4
(*c*) Permanent grass	3,340 ..	21·7
	15,415	100·0

The relation of these types of land (as judged by botanical criteria) to each other may be expressed thus:—

Cultivated land, including tended leys : Outrun leys and permanent grass : : 1 : 1·4

The above statements illustrate very well to what an extent the long rotation is practised in the west. The significance of this is, of course, to be seen in the high ratio the outrun leys bear to permanent grass proper, and this is the more striking when it is realised that the productivity of the permanent grass is considerably better than that of the outrun leys. It is, therefore, the acreage reached by outrun leys that unfortunately affords the surest criterion for estimating the fertility of the soil in Wales and in the western counties generally.

There is, moreover, good evidence to show that by far the most productive of the three categories under which cultivated land has here been classed is, "Cultivated land proper, including tended leys." The poor productivity of outrun leys is apparent by reference to the stock-carrying capacities of carefully selected farms.

Mr. Pryse Howell, who is engaged upon the economic aspects of the survey referred to, has ascertained the stocking of a num-

ber of farms and has reduced these to a single factor expressed in terms of sheep per acre, and owing to his kindness the following statement can be given.*

Six farms at about equal elevation, on which sheep and cattle were kept through the winter, the sheep also having access to the "ffridd," or lower parts of the mountain walks (which were of similar botanical characteristics in each case), were averaged in pairs, and may be grouped thus:—

(*a*) Cultivated land, including tended leys : outrun leys : : 69 : 31
gave a winter stock factor of **1·94.**
(*b*) ,, ,, including tended leys : outrun leys : : 36 : 64
gave a winter stock factor of **1·43.**
(*c*) ,, ,, including tended leys : outrun leys : : 25 : 75
gave a winter stock factor of **1·2.**

More exaggerated cases might have been quoted, but care has been taken to select farms equal in every respect, except for the ratio of cultivated land proper (including tended leys), to outrun leys. These examples, however, with what has already been said, should serve to emphasise what is of the utmost importance at the present time, viz., that crop production increases the stock-carrying capacity of a farm. This statement, however, requires slight qualification, for a study of the methods of husbandry practised, and of the nature of the pastures on farms largely under grass, shows that the aggregate productivity of the land in grass is nearest its maximum when the rotation is carried over the whole farm (with the exception of the real permanent grass), provided always that farmyard and phosphatic manures are sufficiently applied. In such circumstances the gain is greater when no fields are allowed to be down to grass for more than about 4 years than when a more intensive rotation (receiving the same amount of manures and producing the same acreage of crops per annum) is practised on one corner of the holding to the exclusion of the rest. To obtain maximum productivity, therefore, it is desirable to compromise between shortness of rotation and size of holding, and if necessary to obtain all the arable crops that available labour permits of by taking a comparatively long rotation regularly over the whole farm. When, however, expediency dictates a relatively long rotation it is essential that the early cropping should be in part subservient to the subsequent ley, and, further, that a good mixture be used and the ley itself manured.

Summary and Conclusions.— It has been the burden of the present article to show the more obvious defects in the methods upon

* The stock factors are somewhat tentative, the economic survey being only in its initial stages; all the evidence collected, however, goes to show that further investigation will tend to confirm what is here said.

which the system now in vogue depends, for the system cannot be immediately altered, though by energetic action the methods can be rapidly improved. Again, in proportion as a proposed system is complicated, it is necessary that the bed-rock methods of farming should be sound.

It is now generally realised that fundamental alterations cannot be made in our systems of agriculture during the War. After the War improvements in the husbandry on the more elevated regions of the west are almost certain to aim at increased cattle production rather than at the augmentation of our cereal or other food supplies.

Liming.—The writer is of opinion that no substantial improvement is possible in hundreds of parishes in the west until regular liming is reintroduced, and he would be a bold man who would plead for an introduction of continuous cropping, largely dependent as it is upon cruciferous plants, into a district where the practice of liming had completely lapsed.

It is, of course, realised that applications of lime cannot be expected to add materially to the fertility of a soil until after the lapse of 12—18 months. It is equally obvious, however, that immediate expedients for adding to our current food supplies must largely turn on a further use of sulphate of ammonia and on a guarded resort to more intensive cultivation—that is to say, on measures which tend to aggravate a shortage of lime in the soil. It must also be borne in mind that the contribution of the western counties to our resources is to be reckoned chiefly in terms of live stock, supplies of which are not at all likely to become superabundant immediately after the termination of the War. For these reasons current war measures which run counter to the available lime in a district are short-sighted, but such measures, in conjunction with efforts to put the lime requirements of the soil right, spell both immediate and lasting benefit.

In view, moreover, of both the uncertainty as to the duration of the War and our now overwhelming naval supremacy, it may be justly claimed that measures adopted to meet our immediate needs, if they also rob the soil of subsequent fertility, are not justified. Further, any rational improvement put into operation this tillage season, although possibly not adding to our supplies during the War, will tend, nevertheless, to curtail imports at a time when it will be just as important as at present to husband our internal resources.

The chief obstacle in the way of the reintroduction of liming, especially in the more remote parishes, is the difficulty connected

with cartage. Labour has also been getting scarcer for a number of years. Consequently, the old fashion of liming has almost of necessity lapsed.

The introduction of artificial manures is largely responsible for this: "artificials" have become the fashion, they frequently give an obvious return, and on account of their relatively slight bulk may be brought on to the farm in sufficient quantity without repeated journeys to the station. It is a commonplace, however, that people may be induced to purchase all manner of commodities if they are sufficiently urged to do so, and if the wares are brought to their door. It only requires organisation to bring lime to the farmer, and under these conditions not much persuasion to induce him to purchase it.

A lightning survey should be made of the non-calcareous soils in the west, and the districts mapped where the practice of liming has lapsed and where it should obviously be reinstated. The War Agricultural Committees or other authoritative bodies, such as the Agricultural Organisation Society or National Farmers' Union, should then arrange an active lime propaganda in the districts indicated. Lectures might be given, and every farmer visited and asked how much lime he would purchase, delivered at the nearest possible point to his farm. The lime requirements for a county having thus been ascertained, a responsible central body might arrange for its purchase in bulk and delivery in required amounts at the most suitable railway stations for each district.

The greatest difficulty to be encountered would, however, be the conveyance of the lime from certain railway stations to inaccessible farms. Local organisation could possibly arrange for this. In some districts delivery could doubtless be facilitated by the use of motor lorries, and in any event local energy would probably be competent to solve the problem for the various parishes needing assistance. *Now* is the time to consider such schemes as this, so as to pave the way for that extensive agricultural development for which we all look in the near future.

Improvement in Seeds Sown.—Other glaring causes of infertility have been shown to be connected with the quality and kind of seeds most usually sown.* Much can be done and has been done by bringing farmers to appreciate this, but more could be accomplished, and infinitely more rapidly, by directly approaching the local vendors; and, again, *now* is the golden opportunity for doing this. Like every other Briton, the local vendor of seeds

* See also this *Journal*, pp. 1041–1062, as to seed testing.

is a patriotic man. Every single tradesman and co-operative society selling seeds in Wales and the West of England should be approached by somebody having a thorough knowledge of seeds and of the requirements of the various districts in question. West of England and Welsh farmers are addicted to using cheap seeds, but they can be persuaded to buy better ones, and the salesman can be relied upon to do the persuading, provided he can place the responsibility for possible failure on other shoulders. The vendors could also do everything to introduce reasonable mixtures into their districts, provided they knew what are reasonable mixtures. They could also encourage the sale of rape and the seeds of other catch crops, and they should be made to see the futility of supplying poor seeds of crops which it is to their advantage to introduce successfully.

Change of Rotation.—The need of shortening the rotation has been emphasised, but under existing conditions of scarcity of labour not much is at present to be hoped for in this direction.

In regard to moving the rotation over the whole of a farm, the chief drawbacks are lack of water and the difficulty of carting farmyard manure to inaccessible fields. Resort to catch cropping and folding can to some extent obviate the second difficulty. It is, however, often within the power of the landlord materially to help the tenant by arranging for water facilities. He may also erect cattle houses within reasonable reach of the fields whereby manures can be dealt with more or less on the spot.

Catch Cropping.—Ultimately, when auto-driven machinery has become more perfected, it is not unlikely that a considerable extension of the Wibberley system of continuous cropping* will find favour in this and other stock-raising districts.

Many of the recommendations which have been brought forward may appear to some to be too impracticable to be put into immediate operation. Their feasibility, however, depends almost solely on an organised expenditure of energy and good will. All will agree that if such obvious bars to reasonable fertility as lack of lime and phosphates and use of inferior seeds were successfully combated, the productivity of hundreds of farms in Wales and the West of England might be doubled, and in some instances trebled. Until this is done it is well-nigh useless to talk of revolutionising the systems of agriculture there practised, and endeavours to improve the quality of the live stock, however successful, amount at best to putting the cart before the horse.

* Modified, if necessary, to suit the needs of every characteristic district.

The data drawn upon in section (6) of this paper have been collected on behalf of the Agricultural Department of the University College of Wales, Aberystwyth, in connection with an extensive botanical, geological, and economic survey. A full report on this survey will be published by the College in due course. Thanks are due to Mr. Pryse Howell for much valuable information in the preparation of this article.

A NEW FUNGICIDE FOR USE AGAINST AMERICAN GOOSEBERRY-MILDEW.

J. VARGAS EYRE and E. S. SALMON.

Research Department, South-Eastern Agricultural College, Wye, Kent.

Introductory.—Since the introduction of the American gooseberry-mildew (*Sphærotheca mors-uvæ* (Schwein.) Berk.) into this country some 10 years ago and its subsequent establishment in all the fruit-growing centres, numerous investigations have been made to ascertain the best means of dealing with this serious pest both in summer and in winter. It may now be regarded as proved that thorough spraying with the lime-sulphur wash in May and June before the "summer-stage" of the mildew* has reappeared on the young shoots is a practicable, commercial method of protecting gooseberry bushes early in the season.† On many large fruit-farms this spraying with lime-sulphur in the spring is becoming a regular feature in the routine of the cultivation of the gooseberry. Also, researches which have been carried out into the life-history of the mildew have shown the necessity for the early removal and burning of the "winter-stage" at the end of August or beginning of September, in order to prevent the infection of the soil by the "fruit-bodies" containing the "winter-spores."‡ If such contamination of the soil occurs, a sudden and virulent infection of the young gooseberries on the lower branches of the bushes is liable to occur, in spite of all spraying.

The one commercial disadvantage of the lime-sulphur wash s the remarkably adhesive deposit which it leaves on the berries when they are sprayed, so that those which have been heavily sprayed must either be mechanically rubbed against each other

---

* A fully-illustrated Leaflet giving the life-history of the American Gooseberry-mildew can be obtained free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

† E. S. Salmon: *Journ. Board of Agriculture*, March, 1914; *Journ. South-Eastern Agricultural College*, XXI, 394 (1912), and XXII., 403 (1913).

‡ E. S. Salmon: *Journ. Agric. Science*, VI., Part II., May (1914).

under water, or passed through a machine, such as the Fletcher and Becker "Gooseberry Cleaner." If the gooseberries are to be marketed while green, considerable disadvantage may thus attend the use of lime-sulphur, and consequently it has been generally recommended that a solution of "liver-of-sulphur"—which leaves no visible deposit—be substituted for the lime-sulphur wash at times when there is a danger of disfiguring the crop for market.

During the past two years special attention has been devoted in the Research Department of the South-Eastern Agricultural College to the means of controlling, by the use of fungicides, the class of fungi (*Erysiphaceæ*) to which the American gooseberry-mildew belongs, and a large number of carefully-controlled experiments have been conducted. The full details of these investigations will be recorded in the next issue of the *Journal of Agricultural Science,* but the practical value attaching to certain of the results obtained makes it desirable to bring them to the notice of growers immediately. It may be stated at once that these experiments have demonstrated: (1) the inefficacy of the "liver-of-sulphur" solution; and (2) the value of a new fungicide, viz., ammonium sulphide, having special properties which make it worthy of trial by the commercial fruit-grower.

Methods.—The main series of experiments referred to was conducted with the hop-mildew (*S. Humuli*), which was sprayed with solutions of different fungicidal substances, and then carefully observed at short intervals. The work was then extended, as regards the main features tested, to include the American gooseberry-mildew. The method of research was briefly as follows.

The hop plant (a young seedling) was carefully selected as bearing on a number of its leaves numerous young and vigorous patches of the mildew in its *conidial* or summer-stage. Only those patches of mildew were used in which the growth was such as to have produced the densely "powdery" patches so characteristic of the mildew when rapidly spreading under favourable conditions. The solution to be tested was applied in an extremely fine spray by means of a hand "atomiser," sufficient force being used to ensure the thorough wetting of each patch of mildew; "control," *i.e.*, unsprayed, leaves with patches of mildew in the same stage were always present on the same plant. The sprayed leaves were regularly observed from the first day after spraying until the final effect of the solution was observed.

Experiments with Liver-of-Sulphur Solutions.—The first fact of practical importance which was noted was that solutions of liver-of-sulphur, and similar substances, even when applied in a very fine spray, are unable to wet uniformly patches of mildew in the powdery "summer-stage." This fact is due to the presence of air between the separate *conidiophores*, and also between the ripe, detached *conidia*. Aqueous solutions of liver-of-sulphur and similar substances when sprayed on these densely aggregated masses of *conidiophores* and *conidia* collect in minute drops on the surface of each patch of mildew, and will not penetrate it until the wetting properties of the solutions are increased by the addition of a solution of soft soap. From the results observed it is obvious that the use of such sprays without the addition of soft soap should be discontinued.

An extended trial was made of liver-of-sulphur solutions, of various concentrations, with soap, because of the statements which have been made by many investigators as to their efficacy against these mildews in general and against the American gooseberry-mildew in particular. The formula recommended by European mycologists generally is 1 oz. of liver-of-sulphur to 2 or 3 gal. of water, *i.e.*, a 0·31 to 0·21 per cent. solution, while that favoured by American mycologists (making an allowance for the difference between the American and the English gallon*) is a 0·37 to 0·25 per cent. solution. In the United States, in particular, many investigators (*e.g.*, Goff, Close, Beach, Halsted) have stated that these solutions of liver-of-sulphur have proved fungicidal against the American gooseberry-mildew.

Liver-of-sulphur is not a definite chemical compound and is known to chemists to vary very considerably in composition. This fact has recently been brought to the notice of growers in a striking manner in this *Journal*,† and it will be seen that to recommend a particular percentage of this substance may be very little guide as to the usefulness of a wash. When testing the value of liver-of-sulphur as a spray-fluid we have used a freshly prepared sample which was chosen because of its very high sulphur content, viz., 44 per cent., of which 42 per cent. was in the form known as sulphide sulphur; so that it may be considered a superior sample to anything likely to be purchased by the grower.

In the writers' experiments with the hop mildew, repeated trials with a 0·3 per cent. solution of this liver-of-sulphur (prepared so as to contain 1 per cent. of soft soap) showed invariably that at this concentration it was ***not fungicidal***; the patches

* The English gal. weighs 10 lb.; the American gal. 8·345 lb.
† Vol. XXI., 1914, p. 236.

of mildew were more or less checked for the first few days, but, by about the third day after spraying, a fresh growth of the mildew had taken place, and by the fifth to eighth day after spraying, the patches were as "powdery" as they were before. The mildew was greatly checked by a 0·6 per cent. solution of this liver-of-sulphur, but occasionally it recovered completely; at a concentration of 0·8 per cent. the solution was either completely, or almost completely, fungicidal.

The same result was obtained when a 0·3 per cent. solution of this liver-of-sulphur (with 1 per cent. of soft soap) was used against the summer-stage of the American gooseberry-mildew. A gooseberry shoot severely affected was sprayed thoroughly, using a hand "atomiser"; 7 days afterwards the mildew was as vigorous as before the spraying.*

It seems clear from the above results that the use of solutions of liver-of-sulphur of the strengths generally recommended must be discontinued as being mere waste of time and money. It may be noted here that it is the practice of some hop-growers to add a 0·10 to 0·15 per cent. solution of liver-of-sulphur to the "hop-wash" against *Aphis* in the belief that this will combat the "mould" or mildew. In order to make this substance fungicidal it would be necessary to increase the concentration to a 0·8 per cent. solution containing 0·35 per cent. of sulphur, and while this does not appear to cause injury to the hop-leaf, it is probable that a solution of this strength would cause injury, in the form of "scorching," to the tender parts of the hop plant, such as the tips of the shoots, the young leaves, and the "pin" (young flowering shoot). Whatever may be true in the case of the hop, it is certain that a liver-of-sulphur solution of a fungicidal strength, *i.e.*, 0·8 per cent. cannot be used on the gooseberry. A solution of 0·4 per cent. used in some field experiments by one of the writers in 1914† caused serious injury to the tips of the young shoots and to the young leaves. In some field experiments carried out under the writers' directions last summer by Mr. C. W. B. Wright, in Midlothian, and at Kinnaird, Perthshire, a 0·4 per cent. solution of liver-of-sulphur (containing 44 per cent. of sulphur) caused the same kind of injury to the leaves and growing points of the young shoots of "Whinham's Industry." Further, as has often been noted by investigators, the use of even the 0·3 per cent. solution will sometimes cause "scorching" injury, resulting in a more or less serious leaf-fall. It would appear, therefore, that for the control of the American goose-

* See below, p. 1122.

† E. S. Salmon: *Journ. South-Eastern Agric. College*, Vol. XXII. (1913).

berry-mildew liver-of-sulphur solutions must be discarded entirely.

Experiments with Ammonium Sulphide Solutions. — Ammonium sulphide was then used as being a substance leaving no visible deposit, and therefore not disfiguring the gooseberry crop. A stock solution of this was prepared which contained 3·7 per cent. of sulphur, of which 2·2 per cent. was in the form of sulphide sulphur. From this solution various washes were prepared by diluting with water, and adding soft soap so that the final wash contained 1 per cent. of soft soap solution.

A solution of ammonium sulphide containing 0·13 per cent. of sulphur was found to be almost, or quite, fungicidal; when containing 0·22 per cent. of sulphur the solution proved invariably fungicidal.

After obtaining the above results in repeated experiments with the hop mildew, solutions of ammonium sulphide were used against the American gooseberry-mildew in two experiments in the open. In July, 1915, a row of young gooseberry bushes, most of the young shoots of which were densely smothered with the mildew in a very "powdery" condition, was treated as follows:—(1) Six affected shoots were sprayed with a solution of ammonium sulphide containing 0·13 per cent. of sulphur and 1 per cent. of soft soap; and (2) six similarly affected shoots were sprayed with a solution containing 0·26 per cent. of sulphur and 1 per cent. of soft soap. The remaining affected shoots were left unsprayed as "controls." A close examination made twelve days afterwards gave the following results:—In the case of (1) the mildew on four out of the six shoots had been reduced by the spraying to a completely barren and dying condition; one shoot showed a few scattered *conidiophores* on the patches on two leaves; and one shoot showed several minute, almost "powdery," patches on two leaves. In the case of (2) the *mycelium* of the mildew was completely barren and becoming disintegrated on all the six shoots. The mildew on all the control shoots was vigorously growing and densely "powdery."

In the second experiment two mildewed shoots on the same gooseberry bush were sprayed, one with a solution of ammonium sulphide containing 0·22 per cent. of sulphur, and the other with a 0·3 per cent. solution of liver-of-sulphur containing 0·13 per cent. of sulphur.* Other mildewed shoots on the same bush were reserved as "controls." When examined seven days afterwards, the mildew on the shoot sprayed with the ammonium sulphide was entirely barren and partly dried up and dead, while

* It is of interest to note that in both these solutions the sulphide sulphur content was the same.

the mildew on the shoot sprayed with the liver-of-sulphur solution was now densely "powdery" again—this spray, in fact, having had no more effect on the mildew than if pure water had been used. The mildew on the control shoots remained densely "powdery."

In neither of the above-recorded experiments was any scorching injury caused to the foliage or shoots of the gooseberry. In the field experiments carried out last summer by Mr. C. W. B. Wright at Midlothian, a solution of ammonium sulphide containing 0·15 per cent. of sulphur was used on 20 bushes of "Whinham's Industry." These bushes were sprayed fortnightly from the beginning of May until the middle of July, five sprayings in all being given to the same bushes. No injury was caused to the leaves or shoots; according to Mr. Wright's report "the solution appeared to induce a healthy foliage." The above experiment was duplicated on the same scale at Kinnaird, Perthshire, and gave the same results.

The only instance in which injury appeared to be caused by the ammonium sulphide solution was in one experiment in which a solution containing 0·26 per cent. of sulphur was sprayed on the leaves, berries and tips of shoots of a "Lancashire Lad" gooseberry bush growing in a pot in a greenhouse. On the 8th day the older leaves showed decided injury of a "scorching" nature, a slight leaf-fall had taken place, and two berries had fallen off. No further injury resulted.

The results obtained show that ammonium sulphide possesses properties which make it worthy of trial on an experimental scale by the commercial fruit-grower. A solution containing 0·18 per cent. of sulphur (0·1 per cent. of sulphide sulphur) should be used to commence with, and the concentration increased or decreased as circumstances demand.

Since, apparently, ammonium sulphide has not previously been used as a fungicide, its general action on the mildew may be noted here. The patches of mildew when sprayed remain white, and are but little altered in appearance to the superficial view, except that the *mycelium* may be more or less collapsed and flocculent in places; the *mycelium* remains persistently barren, and passes gradually into a dying condition. The fungicidal action is slow, and it may happen that as long as the 18th day after spraying the patches of mildew may still be white, although unable to recover.

Preparation and Dilution of the Ammonium Sulphide Solution.—*Stock Solution.*—One gal. of a 10 per cent. solution of ammonia in water is saturated at ordinary temperature with sulphuretted hydrogen gas, care being taken to avoid the use

of copper utensils and to prevent as far as possible the admission of air to the liquid during this operation. When the liquid is saturated 2 gal. of 10 per cent. ammonia solution are added and also 5 gal. of water. In this 8 gal. of liquor 1¼ lb. of flowers of sulphur are dissolved by agitation in a closed vessel. The addition of the sulphur changes the colour of the liquid from a pale yellow to a dark yellow clear solution, which constitutes the stock solution of ammonium sulphide.

When made according to the above directions, the specific gravity of the stock solution at 17°C. is 1, and it should contain 3·7 per cent. of sulphur, of which 2·2 per cent. should be in the condition known as "sulphide-sulphur." It is miscible with water in all proportions and generally exhibits properties similar to solutions of lime-sulphur and of liver-of-sulphur.

Dilution.—To prepare the diluted wash from the stock solution, 1 lb. of soft soap of a reliable brand is dissolved in 19 gal. of water, and into this quantity of soap solution 1 gal. of the stock solution of ammonium sulphide is mixed by stirring. In this manner 20 gal. of wash are prepared ready for use, containing 0·18 per cent. of sulphur and 0·5 per cent. of soft soap.

It will be noticed that the percentage of soap in the wash as recommended above is half that used in the writers' experiments, but they have reason to believe that in cases where soft water is used this amount of soap will be sufficient. Where the water is very hard, twice the amount of soap should be used.

It will be obvious from the above that the stock solution of ammonium sulphide is not one which can be prepared by the grower himself. Further, since this stock solution cannot in practice be tested by the grower, it should be purchased only from firms of repute who will vouch that it has been prepared according to the methods described above.

In view of the probability that a more concentrated and more potent stock solution can ultimately be prepared, further work on the subject is contemplated by the writers during the coming season. It is, however, not yet known whether in the preparation of stronger stock solutions than that described above the dissolved sulphur will be in the same chemical condition—*i.e.*, have the same fungicidal value—as when the above procedure is followed exactly. The fungicidal value of differently prepared stock solutions will have to be tested in carefully observed experiments before their use can be recommended to the grower.

Cost.—In view of the cheapness of the materials from which ammonium sulphide can be prepared and the simplicity of the operations involved from the manufacturer's point of view, the cost of manufacturing the stock solution should not be prohibitive.

Transport.—The means adopted for the proper transport of the stock solution and the precautions to be taken when handling it should be in every way identical with those adopted in the case of lime-sulphur.

Application.—In applying the ammonium sulphide and soft soap wash, a nozzle giving a fine "misty" spray should be used. The receptacle used in spraying must be wooden or iron (galvanised iron or tinned). A copper knapsack sprayer must not be used, because (as in the case of the lime-sulphur wash and liver-of-sulphur solutions) the dissolved sulphur acts on this metal.

All insecticidal substances which can be added to the lime-sulphur wash—such as arsenate of lead or nicotine—may, if required, be added to the ammonium sulphide solution.

Summary.—(1) Solutions of liver-of-sulphur of the strength generally recommended for use as a fungicide are quite inefficient against the American gooseberry-mildew; at a concentration at which the solution becomes fungicidal, such severe "scorching" injury is caused to the gooseberry bush as to preclude its use.

(2) An ammonium sulphide solution containing 0·18 per cent. of sulphur can be recommended for commercial use, ***on an experimental scale***, for the purpose of protecting the fruit of gooseberries from mildew. In view of its proved efficacy, the lime-sulphur wash should be used for the early sprayings, until its use interferes with the marketing of the berries, when the ammonium sulphide solution should be used.

Notes on Lime-Washes.

THE following notes have been prepared by Mr. J. C. F. Fryer, Entomologist to the Board, and Mr. G. P. Berry, General Inspector for Horticulture to the Board:—

The insecticidal action of lime-wash when applied to fruit trees has always been a matter of controversy, and this is perhaps natural, for the washes in common use vary within wide limits, not only in their composition, but in the period and manner in which they are applied. The following notes deal only with certain aspects of the problem and are not intended as a discussion on the merits of lime washing in general.

Lime-washes in their simplest form are essentially "cover-washes"—that is to say, they imprison or impede the movements of insect pests which may be present on the sprayed trees. Frequently, however, their action is more complex owing to the addition of other substances which themselves may have some specific insecticidal action. There is then a difficulty in deciding whether good results are due to the mechanical action of the lime-wash or to the insecticidal powers of the substances added.

In this connection three cases of successful lime washing observed in 1915 are perhaps worthy of mention.

Case I.—A large orchard containing apples was lime-sprayed, while a second orchard, almost adjacent to the first and also containing apples, was left unsprayed. The sprayed orchard was treated with a wash containing 1 cwt. of quicklime to 60 gal. of water with the addition of a certain quantity of commercial lime-sulphur solution.

The work was carried out during April, and the later applications were made on trees on which the blossom buds had separated and were about to burst. So late was the spraying that some injury might reasonably have been expected, for the trusses in many cases were embedded in a cast of lime. No damage, however, was noted, and the orchard was remarkably free both from apple aphides and apple suckers which were present in abundance in the unsprayed orchard. There is some reason to suppose that the sprayed orchard would in any case have been somewhat cleaner than the unsprayed owing to work carried out the previous year, but the marked difference between the two cannot wholly be attributed to this, and it is believed that the lime washing was in the main responsible.

Case II.—An apple orchard was sprayed during March and April with a "self-boiled" lime-sulphur wash, the ingredients being in the proportions of 1 lb. sulphur, 5 lb. lime, 10 gal. of water.

The last section was not sprayed until the third week in April, when the blossom was in truss and about to open. This section was very free from apple aphides and apple suckers and produced the heaviest crop of apples. Further, it was noted that the foliage remained active unusually late in the autumn.

On the other hand the sections of the orchard which were first sprayed were severely attacked by apple aphides and lost their foliage, which was much injured, comparatively early in the autumn.

Case III.—A damson orchard was sprayed between 10th February and 7th March with a mixture of lime, water-glass and salt (lime 1 cwt., water-glass 5 lb., salt 20 lb., and water 100 gal.).

The orchard was treated in sections which may be indicated as A, B, C, D. On section A there was a severe aphis attack and little fruit was obtained. Sections B and C were less damaged, and the latter produced a fair crop. Section D was sprayed during the week ending 7th March, by which date the condition of the trees was so advanced that injury from the treatment was feared. No damage, however, could subsequently be traced, and section D remained free from aphis attack and produced a very

Discussion.—The above notes were made in commercial orchards which could not be kept under the close supervision possible in an experiment station, and they therefore lack many of the detailed observations which are usually desirable. At the same time in each case there were areas which acted as controls, and it seems permissible to draw certain conclusions.

In the first place, it would appear that an effective control as regards aphides was obtained whenever the trees were sprayed at a very late period—in fact, shortly before the blossom opened. Secondly, this late spraying caused no damage whatever to the foliage and blossom, though previously, from their advanced condition, some injury was anticipated. These conclusions apply equally to the apples and damsons, for the condition of the blossom at the dates of spraying was approximately the same in each case.

Finally, the sprays which produced these results differ materially in composition and need more detailed consideration. That used in Case I. contained a very high percentage of lime with the addition of boiled lime-sulphur solution—that is to say, a solution containing various chemical compounds of lime and sulphur, some of which are supposed to have a definite action on certain insects—notably, scale insects. In Case II. a "self-boiled" lime-sulphur was used. This wash differs from boiled lime-sulphur in that the entire heat required for its manufacture is produced by the lime when it is slaked and no fire is used to prolong the boiling. When made under ideal conditions it is believed that the sulphur is only reduced to a very fine state of division and that little of it enters into chemical combination with the lime. It differs radically, therefore, from boiled lime-sulphur, in which all the sulphur is combined with lime. In the formulæ given, however, there is a great excess of lime as compared with more usual formulæ for the preparation of this wash, and it is possible that a considerable proportion of the sulphur may have combined with lime. It would be unwise, therefore, to suggest the final constituents of the wash used, but it is evident that there must have been a great excess of free lime. The wash, however, was evidently "thinner" than those employed in Cases I and III.

In Case III., though the details are a little uncertain, it appears that a thick lime-wash was used with the addition of salt and water-glass. The action of the two latter substances is uncertain, but from some experiments it would appear that the salt may have some insecticidal properties. The water-glass, however, is only supposed to assist the lime in adhering to the trees,

Comparing the three different washes which, in spite of their difference in composition, seem to have had much the same result, it appears evident that their insecticidal action must have been due primarily to their mechanical or "covering" properties. It would be unwise to speculate as to whether this action was exerted on the eggs of the aphides or on the newly-emerged insect, but in either case there seems no doubt that the more nearly the time of treatment approaches the hatching period of the insect the less important is the exact composition of the lime-wash and also the greater the chance of success.

The Cultivation of Buckwheat.

BUCKWHEAT is a native of the temperate parts of China, North West India and Central Asia, and is grown as a cultivated crop to a greater or less extent in most European countries in the temperate zone, and also in the United States and Canada. In Europe the crop is not so popular as it was, but large areas are still grown in Russia and France. The name "buckwheat" is probably a corruption of the Dutch "boekweit" or the German "buchweizen," or beech wheat, from the resemblance of the "seed" to the beechnut. Botanically buckwheat is not a cereal, but for agricultural purposes it is usually included among that class of crops.

In this country buckwheat is now grown only to a limited extent, chiefly on pieces of waste land to supply food for pheasants and other game, or on poor sandy soil as a green manure crop. This is mainly due to the fact that on land on which the ordinary farm crop can be satisfactorily grown the economic return from buckwheat is less than from the cereal crops. It is probable, however, that even in normal times the crop could be grown with advantage more extensively than it is, especially on the poorer soils and as a first crop in the reclamation of waste lands. At present buckwheat should commend itself for a number of reasons. It is sown very late in the season and can, therefore, take the place of crops which have failed or which have not been sown owing to pressure of work in other directions. At a time like the present, when any means of increasing the aggregate production of home-grown food is of importance, it is a point in its favour that the crop can be grown on land on which an ordinary cereal crop would yield indifferently or even prove a failure. The cultural preparation for the crop may, if necessary, be reduced to a minimum. It should be added that in common with the cereal grains the price of buckwheat has

increased and is now 40*s*. to 44*s*. per qr., as compared with 32*s*. to 35*s*. per qr. before the war.

Varieties.—There are three main varieties of buckwheat in cultivation, viz., the common type (*Polygonum Fagopyrum*, L.) Tartarian buckwheat (*P. Tartaricum*) and the Notch-seeded buckwheat (*P. emarginatum*). Of these the first-named variety is the only one in general use. Tartarian buckwheat is a smaller seeded variety and is considered better suited for poultry food, but is a somewhat shy cropper.

Description of Plant.—Buckwheat is an annual plant of erect habit of growth; under favourable conditions it may reach the height of 3 ft., although late-sown crops are usually somewhat shorter. The roots consist of a primary root with several branches and are, therefore, quite different from those of the true cereals. The stem is greenish or purplish red in colour, but changes to brown as the plant matures. Only one stem is produced from each seed, but the plant branches freely and thus adapts itself to the rate of seeding. The flowers are white, slightly tinged with pink.

Climate and Soil.—A moist, cool climate is best suited to buckwheat. The plant is very sensitive to low temperatures and is generally destroyed in a single night of frost; on the other hand the yield may be reduced by a continuous spell of dry weather during the later period of growth. The crop will thrive on a wide range of soils, but does best on a warm, well-drained, sandy loam. It will grow on dry sands and gravelly soils on which other crops would be very precarious, and will also often do well on peat land. Cold, wet lands, however, are not suited to it. Apart from the fact that buckwheat is hardly likely to compete with the usual cereal crops on the richer soils, there is a tendency for the crop to lodge badly, and as the plant is unable to recover, this is a serious matter.

Place in Rotation.—Buckwheat seldom occupies any special position in a rotation. It is usually sown on the poorest soil or as a substitute for a corn crop which has failed. It leaves the heavier soils in very mellow condition and therefore forms a good preparatory crop for roots.

Preparation of Land.—The cultural operations in the case of the buckwheat crop are usually reduced to the barest requirements, but it may be pointed out that more thorough preparation is well repaid. If possible the land should be ploughed early in the winter and subsequent operations should be directed towards obtaining a good tilth.

Manures are rarely applied directly for buckwheat, the residues from applications given to previous crops usually being considered sufficient. Moderate applications of artificial manures, especially phosphates and potash, will, however, result in largely increased yields. On poor, sandy soils some farmyard manure should be applied if available.

Sowing the Seed.—The grain used for seed purposes should be of good weight and, if possible, selected from the previous season's crop. As the crop is exceedingly sensitive to frost the seed should not be sown until the end of May or beginning of June. When intended for a grain crop the quantity sown per acre should usually be about 1 bush., although up to 3 bush. may be required when broadcasting is resorted to. If drilled the distance between the rows should be from 12 to 15 in. As little moisture is needed for germination it is a mistake to bury the seed too deeply, ½ to ¾ in. being sufficient. Provided the land has been well cleaned before sowing no further cultivation will be required until harvesting.

When intended for use as a green manure crop the seed should be sown broadcast up to the middle of July at the rate of 2 to 2½ bush. per acre. It should be ploughed in when the plants commence to flower.

Harvesting.—If the conditions of growth have been favourable, the crop is usually ready for cutting in about 12 to 14 weeks from the date of sowing, *i.e.*, the end of August or the beginning of September. The selection of the correct time for cutting is an important matter, for the seeds ripen unevenly, and if the crop is left too long the earlier matured grain may be shed, while if it is cut too soon a proportion will be still unripe. Ripeness is indicated by the general browning of the crop, but even then flowers will still be noticeable on the lower branches.

The crop is probably best cut with a scythe or a mower, but, if desired, a self-binder may be used. In the latter case the sheaves are set up in shocks and usually threshed as soon as dry. Where the crop is mown it is turned several times as gently as possible for the first day or so; in many districts it is then placed in loose heaps through which the air can circulate freely. Proper harvesting of the crop may take from 10 to 14 days. When "made" it is frequently threshed at once; if it is desired to store it the stacks should be quite small. In threshing the smooth concave should be used in order to avoid cracking the grain and unnecessarily breaking the straw.

Yield.—The yield of grain varies widely, the average being

about 3 qr. per acre; on poor soils in bad seasons it may be less, while on richer land in a good year it may amount to as much as 6 qr. per acre. A bushel weighs about 50 lb.

Uses of Buckwheat.—*Bread, etc.*—In many parts of the Continent buckwheat bread still forms the staple diet of the poorer classes, while in the United States large quantities are used for human food in the form of buckwheat cakes, buckwheat groats, etc. The buckwheat is ground and the outer black hull separated. Properly ground buckwheat flour has a more or less dark tint due to the presence of fine particles of the outer envelope which are not removed with the hull. The grain must be well dried, and to secure the best results in milling the grinding should be performed in cool, dry weather. Under favourable conditions 100 lb. of grain will produce 60 lb. of flour, 24 lb. of middlings and 16 lb. of hulls.

Milling Process.—The milling process is described by Wiley in "Foods and their Adulteration" as follows :—

"During the process of milling the buckwheat grains pass to a receiving separator which removes all the coarse particles, stones, straws, etc., by means of a series of sieves. At the same time any dust which they contain is blown out by a current of air. The sifted grains pass next to the scouring machines, in which they are thoroughly scoured, cleaned and polished. From these machines the grain is passed to a separator containing magnets by means of which any pieces of metal, in the form of nails, screws, pieces of wire, etc., are removed.

"The grains next pass through a steam dryer for removing the greater portion of the water employed for the scouring. As soon as they are dry they are again treated to a blast of air, which removes any dirt, dust, or light particles which may have been detached during the process of drying. The grains next pass to the shelling rolls, where the greater part of the outer hulls is removed. This process is accomplished by means of an apparatus which is called a sieve scalper. After the separation of the outer hulls the residue of the material passes through a drying chamber, where the moisture is reduced to about 10 per cent., thus insuring the keeping qualities of the flour. After drying, the grains are ready for the rolls. After entering the rolls the process is practically the same as that which is employed in milling wheat, consisting of a series of breaks and reductions, with the attendant bolting and grading, and this process is prolonged until the flour is practically removed from the feed or middlings. The sifting cloths used in the bolting of buckwheat flour are somewhat coarser than

those for wheat, and this allows some of the dark particles of the inner hulls to pass into the flour, which gives it a dark colour on baking. It is quite possible to make a buckwheat flour as white as that from wheat, but in this country [America] the public taste requires a darker product, so that the white flour does not readily sell. The requisite degree of darkness is secured by using bolting cloths which will allow a part of the inner hull (middlings) to pass into the flour. Two grades of flour are generally produced—a whiter one in which finer cloths are used, and a darker flour made by using coarser bolting cloths, allowing larger quantities of middlings to pass through.

" The above process, while it makes a white and fine-looking flour, is not to be compared with the meal made in the old-fashioned way by grinding between stones and separating the principal part of the outer hull by bolting. This old-fashioned flour is more nutritious, that is, it contains more fat and protein, has a greater fuel value, or in other words has a greater number of calories and makes a much more palatable cake than the fine modern flour."

Use as a Feeding Stuff.—The buckwheat grain is characterised by a somewhat high fibre content, otherwise it is similar in composition to barley. The following analyses are chiefly from American sources :—

Analyses.

——	Water. %	Protein. %	Fibre. %	Carbo-hydrates. %	Fat. %	Ash. %
Grain	12·6	10·0	8·7	64·5	2·2	2·0
Straw	9·9	5·2	43·0	35·1	1·3	5·5
Grain (hulled) ..	13·0	13·1	2·2	67·2	2·5	1·9
Bran	12·8	10·6	30·7	38·9	3·0	4·0
Hulls	11·2	4·0	45·5	36·9	·8	1·7
Middlings ..	12·7	28·1	4·0	42·4	7·0	5·1
,, ..	13·0	20·6	2·8	55·4	5·2	3·0

Whole Grain.—The whole grain is of value as a poultry food, but the indigestible nature of the hull renders it an undesirable feeding stuff for general feeding purposes. The grain should only be fed in moderate quantities in a mixed ration.

Ground Buckwheat and Buckwheat Bran.—The composition of ground buckwheat varies within wide limits according to the proportion of hulls present. In small quantities in mixed rations ground buckwheat may be fed to most classes of live-

stock, but it is best suited as a fattening food for cattle and pigs; small quantities may also be fed to horses, but it is unsuited to young stock.

Buckwheat Middlings.—Buckwheat middlings form the most valuable buckwheat offal. They are practically free from hulls and may be fed to all classes of stock. Like ground buckwheat, however, they vary widely in composition. Many samples contain a high percentage of protein and fat and are much in demand as a food for dairy cows. The middlings may also be fed with skim milk for calf rearing.

In Belgium finely-ground buckwheat is extensively used for poultry fattening. In France also ground buckwheat and finely-ground barley meal are used for the same purpose. As a fattening food for ducks and geese a mixture consisting of three parts of buckwheat and one part of maize has been recommended.

Fodder Crop.—As a fodder crop buckwheat is best sown in a mixture with oats, mustard, etc. A good mixture is 40 lb. of buckwheat and 15 lb. of white mustard per acre. In Hungary a mixture of equal parts of buckwheat, field peas and vetches is recommended as a fodder crop for dairy cows.

The crop should be cut at about the time the buckwheat commences to bloom; in a fresh condition it contains on an average:—

	Per cent.
Dry matter	16·4
Protein	2·5
Crude fat	·6
Carbohydrates	7·6
Fibre	4·5
Ash	1·2

On account of its high moisture content the crop is most suitable for cattle, but it should not be fed in greater quantities than 50 lb. daily per 1,000 lb. live weight.

When it is possible to dry it adequately, buckwheat makes good hay. Usually, however, the drying process takes too long and it is preferable to make silage of the crop.

Buckwheat Straw.—Buckwheat straw is seldom used for feeding purposes, as its high fibre content renders it somewhat indigestible. On occasions, however, when other fodder is scarce, it may be fed to cattle and sheep with advantage. As litter the straw does not last well, but it makes good bedding for cows. As it is rich in mineral matter and rots quickly it also forms good manure.

Green Manure Crop.—As a green manure crop buckwheat has several advantages; it thrives on poor soil; it grows rapidly and smothers out weeds, thus helping to clean the land. It leaves hard soil in a mellow condition and decays quickly when ploughed in.

Disease due to Buckwheat.—When buckwheat products are fed in excessive quantities over long periods they may produce poisonous effects. The symptoms include congestion of the head, some delirium and, finally, considerable swelling of the head with eruptions on the skin. These symptoms will usually quickly disappear if the food is changed and the buckwheat portion eliminated.

References.—Handbuch des tierischen Ernährung, Pott.
Cornell, Bulletin No. 238.
"Cereal Crops," Hunt.

The Growing of Mustard Seed.

THE question of growing mustard for seed is worthy of consideration at the present time. Two species of mustard are met with in cultivation—the *white mustard*, with yellow seeds, and the *brown* or *black mustard*, with brown or dark-coloured seeds. The former is best known as a catch-crop for sheep feed or for ploughing in as green manure, and for the production of seedlings for salad. The crop, however, is also grown extensively in some districts for its seeds, which are used in the manufacture of mustard for domestic purposes. The latter, or brown species, is cultivated solely for its seeds. These are ground, and the flour, after admixture with a proportion of the milder and less pungent flour of the white mustard, is used for making the well-known condiment.

At the present time brown mustard is quoted on the London Market at £7 16*s*. to £7 18*s*. per qr. (448 lb.), and white mustard at 10*s*. per qr. less. These prices, which are much above the average for the past few years, are attributable to a number of causes, including a lessened home production due to unfavourable weather during the early stages of the growth of the crop, the stoppage of imports from the Baltic ports, and an increased demand from America. In normal times the market for home-grown mustard is strictly limited, and any considerable extension of the area under this crop would be attended with some risk, but so long as the present conditions continue there is likely to be a good market at home with the probable continuance of a demand from abroad.

It would be well, however, to confine the growing of brown mustard for seed to those areas that have proved best adapted for the purpose in the past, viz., the good fenlands and marshlands of Lincolnshire, Cambridgeshire, Huntingdonshire, and Norfolk, as this crop requires a deep, moist, well-drained fertile soil, free from acidity. There is one serious drawback to the cultivation of brown mustard. The seed, especially if the crop is over-ripe, is apt to shell out at harvest and cause trouble in subsequent crops.

White Mustard.—This article deals mainly with the conditions best suited to *white* mustard, as it is adapted to a much wider range of conditions than brown mustard, both as regards soils and weather, and causes less trouble from shed seed. It can be grown more or less successfully on all kinds of land, and is a safe crop to take on freshly-ploughed grass-land as wire-worms attack it only slightly or not at all. On heavy, clay lands, it is often taken after dead fallows, the following crop being wheat. This system invariably proves a great success, both as regards the mustard and the wheat. On heath and light lands, white mustard is taken before barley. It is said that where turnips will grow white mustard will succeed.

Seed Bed.—The ground requires thorough preparation, and a fine and fairly solid seed bed is essential.

Manuring.—If the land is in good heart the only manure needed is 3 to 4 cwt. of superphosphate per acre. In other circumstances a good dressing of farmyard manure, say 10 to 15 tons per acre, should be given, in addition to the superphosphate.

Seeding.—White mustard may be drilled at any time from the first week in April to the middle of May. If it is sown earlier it runs the risk of being cut off by frost, but if the earlier sown crop is successful it has the advantage of coming to harvest before the corn harvest begins. The seed should not be buried more than half an inch, or it will not germinate evenly; it is usually drilled on the flat in rows 12 to 18 in. apart. Some growers drill 12 in. and chop out the plants 9 in. in the rows or, to save labour, run the horse-hoe across the crop; on good land the plants require more room to enable them to branch. If the seed-bed is sufficiently fine, half a peck of seed, or slightly less, will be ample for 1 acre.

Harvesting.—Great care should be exercised in judging the correct time to cut: if cut too early the seed will be green and shrivelled, while if it gets too ripe there is great loss through seed shelling on the land, especially in windy weather. Old growers say they wait until the colour of the pods assumes the

brownish tint of a hare's back. It is advisable to cut the crop slightly on the green side and give it plenty of "field room" to enable the plant to dry out thoroughly. White mustard is generally cut by hand with sickles, and laid on the ground in small bunches; but when there is a scarcity of labour or the men are not used to this form of cutting, the ordinary corn binder does the work well. Small sheaves should be made and not tied too tightly, and the crop should be cut as high as possible so that the high stubble may form a good resting place for the sheaves. The sheaves should be turned after two or three days, and carted when thoroughly dry. In carting, care must be taken to prevent loss of seed; cloths should be put over the racks or frames fixed to the carts to catch the shed seed, and this should be distributed over the stack from time to time and not laid in heaps, or the seed will turn mouldy.

Stacking.—A good "staadle" is necessary. This may consist of faggots or brushwood covered with straw or coarse grass on top of which should be placed a cloth or old bags to catch the shelled seed. The stacks should be relatively small, about four yards wide, to prevent over-heating. In some districts, stacking is obviated by threshing the crop in the field.

Threshing.—This is done with the usual tackle, the only extra parts required being four sieves of smaller size than those in normal use; such sieves can usually be supplied by the makers of the threshing machines.

Yield.—The yield varies very greatly. It may be as much as 40 bush., but is normally about 16 to 20 bush., or a little more, per acre.

The chaff (pods) is used for feeding; the straw is practically of no value for fodder, but may be used for the bottoms of stacks and cattle yards, and it is used in some parts to form shelter walls around open cattle sheds.

Seed Potatoes.

IN the warmer southern and south-eastern districts of England it has long been recognised by the principal growers that a change of "seed" from Scotland or from Ireland is desirable *every* year. In the cooler parts of England a change every second or third year is considered sufficient. It is well established that climatic and soil conditions do exert an important influence on the vitality of seed tubers. It is held by some authorities that a moist, somewhat acid soil provides the best change. Where it is impossible this year, in view of transport difficulties, to obtain the desired change, growers, in using home-

grown seed, should be careful to plant only those tubers showing vigorous signs of life. It is desirable, therefore, that all seed tubers should be sprouted before planting, either by "boxing" or by spreading in a thin layer on a suitable floor, and, in the absence of northern-grown "seed," cut "ware" tubers, direct from the north or obtained from once-grown northern stock, should be used in preference to whole "seed" grown locally. Further particulars on the subject will be found in the Board's leaflet No. 173 (*Potato Growing*).

In connection with the subject of "seed" potatoes the following notes on experiments made in America on the mulching of crops grown for "seed" will be of interest.*

Potato growers in the United States, as in this country, have long recognised the necessity of obtaining, from time to time, a new stock of seed, preferably from a northern district, in order to overcome the gradual deterioration which occurs if home-grown seed is continuously employed. The superiority of northern-grown seed is believed to be primarily due to the cooler soil, which enables the tubers to mature more slowly and equably than would be possible in a warmer district. It was thought possible that the application of a mulch of straw or similar material to seed potatoes in their native districts might afford low and fairly uniform soil temperatures similar to those which assist the complete development of northern-grown seed. Tests were, therefore, carried out from 1904 to 1912 at the Nebraska Agricultural Experiment Station to determine the value for seed purposes of mulched home-grown tubers in comparison with northern-grown tubers and with those grown at home by ordinary cultivation methods.

In testing the relative merits of the two sorts of home-grown potatoes, care was taken that the mulched and unmulched seed should receive identical treatment as regards storage and subsequent planting. The superiority of the mulched seed over that raised by ordinary cultivation was very marked throughout the test. For each 100 lb. of produce obtained from mulched seed the yield from unmulched seed ranged from 77 lb. after one year's test of each down to 54 lb. after 8 years' continuous reproduction. It was found, moreover, that even one year of ordinary cultivation greatly reduced the strength of a stock previously mulched. Thus, a stock which had been mulched for 8 years yielded 60 per cent. more than part of the same stock unmulched for one year after having been mulched for 7 years.

Comparisons of home-grown mulched stocks with stocks

* University of Nebraska, Agric. Expt. Station, Bull. No. 146.

imported from a northern district showed that, on the average, for each 100 lb. produced by the former the latter yielded 98 lb.

The extra cost entailed in producing seed tubers by mulching with straw instead of by cultivating between the rows was estimated at about £2 2*s*. to £2 10*s*. per acre. At this rate the extra cost would not be more than about 5*d*. or 6*d*. per bush., and if mulching increases the yield by as much as from 20 to 25 per cent., as may ordinarily be expected, the cost per bushel should not differ greatly for the two methods. In the Nebraska district the price of northern-grown seed at planting time is from 20 to 30 per cent. higher than that of home-grown cultivated tubers, representing a difference of, perhaps, 10*d*. to 1*s*. per bush. It is claimed, therefore, that a grower can produce high-class seed potatoes at home by mulching at a cost somewhat less than he can buy northern-grown seed of equal quality. This point appears to be worthy of consideration in this country.

The bulletin recommends that a few rows of potatoes should be mulched along one side of the field to furnish seed for the next year's crop. The mulch may consist of hay, straw, stable litter, or other coarse material free from grain and noxious weed seeds, and should be about 4 in. deep after settling. A deeper mulch adds greatly to the cost and may impair the growth of the plants. The mulch is best applied before the plants come up, and must in any case be spread by the time the new tubers begin to develop. To ensure that the plants are strong enough to grow through the mulch, and to produce as high a yield as possible for a given amount of mulching, large pieces of seed (from 4 to 6 oz.) should be planted at a depth of about 4 in. It is stated that the only conditions under which mulches, properly applied, are likely to reduce the yield are excessively wet weather or soil that is not well drained.

It should be emphasised that the estimates of cost are based on the assumption that a supply of suitable mulching material is available on the farm, no allowance being made for the value of the material used. If the mulch has to be purchased it is extremely doubtful whether the process would ever be practicable on the farm, since these experiments appeared to show that from 17 to 20 tons of straw or other litter may be needed to mulch 1 acre of potatoes to a depth of 4 in.

Where, however, sufficient litter is available mulching might prove useful in growing "seed" of new and expensive varieties, and in raising small stocks of seed: a small patch intended for seed might be dressed with artificials in the rows, and the ordinary dressing of stable manure might be applied as a mulch between the rows.

The Rearing of Chickens.*

SUCCESSFUL poultry-keeping depends largely upon the methods adopted in rearing chickens, and at the present time when there is so much need for improvement and for an increase in the stock of poultry, it is important that all those who rear chickens should adopt methods which will produce healthy and vigorous stock and will at the same time secure economy in feeding and labour.

In this article attention is drawn to two typical systems of rearing which have been found successful in practice. It is not necessary that they should be rigidly adhered to, but they are tested methods which will guide those who have adopted no definite system in the past.†

There are two recognised systems of chicken feeding, viz., the wet mash system and the dry feeding system, and each has its advantages. Of late years, however, the latter has become increasingly popular, as it effects a great saving of labour; the grain mixture may be scattered among the litter in sufficient quantity to last all day, while the chickens derive great benefit from the exercise entailed in scratching for the food. On the other hand, wet mash feeding is usually favoured when table poultry are required. For general purposes a judicious combination of the two systems will probably produce the best results.

SYSTEM I.

First Week.—During the first week of their existence the main requirements of the chickens are adequate heat and protection, and the development of their sense of direction and power to forage for food.

Methods Suggested.—From the time the first egg begins to chip in the incubator the machine should be closed and not opened again for 24 hours. During this time a steady temperature of 104° F. should be maintained. At the end of 24 hours the chickens should be removed to their brooder in a basket that is well lined with soft, dry grass, hay, or two layers of an old blanket. They should be covered up directly they are placed in the basket, as any exposure causes them to lose some of their body heat. Crippled or weakly chickens can rarely be reared profitably and should be destroyed at once as humanely as possible.

* Reprint of Special Leaflet No. 54, just issued, copies of which will not be sent to subscribers to the *Journal* without special application.

† Further suggestions for the feeding of chickens are given in Leaflet No. 114 (*Feeding of Poultry*).

To ensure the best results, no more than 50 chickens should be raised in one flock—at all events during the early stages of rearing. Overcrowding, whether it be in a brooder, coop or house, is a fatal mistake.

Preparation of the Coop or Brooder.—Any suitable form of coop may be used. One of the most inexpensive and convenient forms is the calico coop, which has already been fully described and illustrated in this *Journal*, January, 1916, p. 975.

This coop has a floor space of 6 ft. by 6 ft. and a substantial frame or skirting which surrounds its floor and encloses and supports the litter bed.

The Litter Bed.—This may consist of short, dry, lawn clippings or soft meadow hay cut up as finely as the chaff cutter will allow. Short cut clover or lucerne is also an excellent litter for chickens. The chickens will consume large quantities of this litter, and it should therefore be regarded as forming a considerable proportion of their bulky food. This being so the litter should be changed directly it becomes tainted. A deep litter bed will often suffice for two flocks of chickens without becoming tainted, but its life will depend upon the dryness of the land, the weather, and the care expended in adjusting the roof of the coop so as to exclude driving rain. Any portion of the bed which may become wet should be at once changed.

The best position upon which to raise chickens is a fine grass turf in which there is a good admixture of White Dutch Clover. The ground should, if possible, be dry and level, and the grass kept short.

The coop should be placed upon a couple of cross supports so that its floor just clears the ground. Each of the four sides of the coop in the illustration has a small trap door, opening directly across the upper edge of the floor frame or skirting, and fitted with a short ladder board to allow the chickens to enter and leave the house (p. 1141).

The litter bed should be made level with the top edge of the door frame—a depth of 9 in.—and the dry food should be evenly distributed throughout the litter. If this has been satisfactorily done a grain or two of chick food can be found within every square inch or so of the litter.

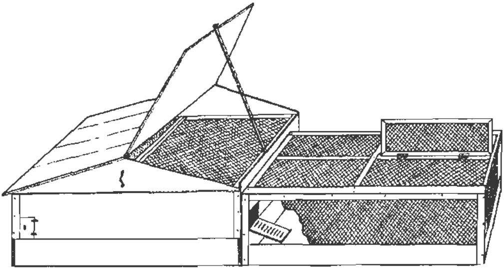
After the dry chick food has been added and the surface made level, the birds should not be interfered with again until they have removed most of the dry grain.

Feeding.—The following chick feed, mixed thoroughly in equal parts by measure, has been found to give good results:—

1. Finely kibbled wheat. | 3. Rolled breakfast oats or

The smaller the particles of grain the longer the chickens must work for its recovery. In passing the grain through the kibbling machine a certain proportion of flour is produced. This fine material should be sifted out of the mixture, and used in the dry mash, as it would not be recoverable from the litter. The wheat and oat flakes of this mixture will retain their positions in the litter far more evenly than small seeds and grains.

Provision of Artificial Heat.—A portable hover should be prepared and placed upon a square board which rests upon the surface of the deep litter bed in one corner of the coop. The



board should be just large enough to form a floor for the hover. Upon it should be placed a bed of long wheat straw of sufficient depth to keep the chicks from coming into contact with the board at any point. This long straw, if properly laid down, with the blades arranged more or less in a circle, will act as a filter for the droppings which dry and fall through the straw on to the surface of the wood. The droppings can be removed every day or every second day according to circumstances. Straw so placed remains in position and cannot be scratched away by the chickens.

It is of great importance to regulate the temperature so that it meets the requirements of the chickens; extremes of temperature should be carefully avoided. A thermometer cannot be regarded as a sufficient guide in itself, and it is better to observe closely the action of the chickens themselves. If the hover is too cold, the birds will crowd towards the lamp, a practice which is very detrimental to their health. It is a habit easily acquired and, if once learnt, only eradicated with difficulty. If, on the other hand, there is too much heat, the chickens will pant, become restless, and separate from each other in their desire to secure a cooler environment. The conditions may be considered suit-

able when the chicks are sleeping quietly, more or less apart, and resting on the straw.

As the temperature of the hover rises when chickens are placed beneath it, owing to the addition of their body heat to the heat of the lamp, it is best not to make any alteration in the latter for about one hour after the chickens have been moved from the incubator. As a rough guide the thermometer should then read 90°F. From day to day this heat will tend to rise owing to the flock increasing in weight and heat-producing power; the instructions issued with the machine should therefore be followed and the condition of the birds should be carefully watched. As a general rule it may be stated that artificial heat should be gradually reduced until, at the end of about 4 weeks, the chickens no longer require it.

When the chickens have been safely transferred from the incubator to the brooder their movements should be very restricted for the first forty-eight hours. To effect this, a strip of matchboard enclosing a small triangular space of litter bed is placed outside the hover. In this space a suitable chick water fount should be placed, and also a shallow hopper containing dry mash.

The dry mash at this stage may consist of equal parts of dry wheat bran and rolled breakfast oats and should be kept continuously before the birds. If the chickens are placed once or twice within the hover, they will readily learn to go in and out seeking the mash when they require it. The exercising ground can then be extended by degrees until the whole bed is available for scratching.

After three days rolled oats should be omitted from the dry mash, for the purpose of economy, but bran should be kept constantly before the chickens. Finely divided, fresh, and tender green food, such as lettuce or dandelion, should also be constantly available so that they may soon learn to eat it.

A supply of chicken grit should be placed in a small box, and a sanitary water supply at all times is absolutely necessary. To guard against disease a few crystals of potassium permanganate should be added to the water. Once the solution in the water fount loses its characteristic light claret shade it should be changed without delay. An inverted water bottle fount is an excellent appliance for very young chickens.

Second Week to Fourth Week.—From the second to the fourth weeks the chief requirements of the chickens are suitable food, plenty of open air exercise, heat to a decreasing extent, and protection.

Methods Suggested.—If the weather is at all suitable, the chicks should have daily access to a limited area of good grass turf. It is waste of time and labour to place them on turf largely composed of coarse grass tufts.

To provide frequent changes to fresh turf, without moving the coop for some time, it is an advantage to have a trap door in each of the four sides. A wooden frame should be constructed as shown in the illustration. It should have a floor space 6 ft. by 6 ft., and should be sufficiently high to cover the trap doors. The top and sides of this cage should be covered with 1 in. mesh wire netting in order to exclude sparrows and other vermin.

A tarpaulin made of unbleached calico (cheap grade), proofed with two coats of hot boiled linseed oil to which a proportion of gelatine has been added, may be placed in position to cover the roof of the cage but not its sides. A few eyelets and light lashings are also necessary. The semi-transparent cover should be kept in position during showery or uncertain weather and removed when the weather is fine. The chickens should always be confined to the coop itself towards nightfall.

The cage can be moved to any given plot round the coop itself, until all four plots are soiled when it is time to move the house to fresh ground. It is an advantage to place the dry bran hopper and water fount within the cage.

Feeding.—The following foods are suggested:—

(*a*) The dry chick food of the litter bed.
(*b*) A constant supply of dry wheat bran.
(*c*) Grit, green food, and fresh water.

In addition to this, from the second week onwards, the birds should receive a small quantity of animal food, such as beef scrap, fish meal, milk or butter milk (always sour or always fresh), or bullock's liver. The chickens should be given all they can eat up very quickly once a day—say at 12 noon. A good method of feeding milk is to cut several slices of stale bread, soak them in milk and feed them whole.

Fifth Week to Seventh Week.—About the end of the fourth week, if the weather is favourable, the chickens may be transferred from the heated brooder to fireless brooders.

About the sixth week dry mash is substituted for the bran. It should be very thoroughly and evenly mixed, and may be prepared as follows:—

Stock Mash (by weight).—

Maize meal	27 lb.	Linseed meal ..	3 lb.
Sussex ground oats ..	30 ,,	First quality fish meal	10 ,,
Middlings	30 ,,		

Dry Mash as Fed (by measure).—

Stock mash	1 part.	Dry wheat bran ..	4 parts.

This may be kept always before the birds up to the eighth week, discarding the milk or meat formerly fed at noon.

At this stage the young stock should have access to larger grass runs. Indeed, this step may with advantage be taken from the fifth week onwards provided the weather conditions are favourable.

Eighth Week.—About this time the birds are not so energetic in working in the litter, and otherwise show a tendency to become inactive, even when at liberty. They are inclined to grow "lean and lanky rather than fat" and their crops, if examined when night falls, will not be nearly so well packed as usual.

The deep litter feeding and the continuous application of dry mash should cease and whole wheat or finely cracked maize, or a mixture of both, should be provided at the rate of one good handful per bird per day.

The grain should be measured out as suggested above and divided into two equal parts, one of which should be fed first thing in the morning and the second about 11 a.m.

The grain should be evenly distributed over and well raked into the litter bed. The birds should also be provided with *all* the tender green food they will consume without waste during the morning hours.

At 1 p.m. a very small amount of moist mash or bread and milk should be fed. The stock mash mixture, to which four parts by measure of steamed bran and a moderate amount of milk or butter milk have been added, will be just what the birds require. They should be allowed four to five minutes' access to the food which should then be removed.

At 2.30 p.m. the dry mash hoppers should be opened and the birds allowed to have all they can consume before night. In order to ascertain whether the feeding is likely to carry them safely and evenly towards maturity, a proportion of them should be examined every night after they have gone to roost. Should examination of the crops of the birds prove that they are only partially filled, less moist mash should be fed at 1 p.m., or the dry mash should be still further reduced by opening the hoppers at a later hour. It is most important to ensure full crops at nightfall.

Treatment of Cockerels.—It is very important to separate the sexes at an early date. Once the cockerels reach maturity one handful of good grain per day fed in the litter for each bird, with plenty of green stuff, and access to free range for several hours

each day will keep them in prime condition. The birds may also have access to the dry mash hoppers for one hour just before nightfall. Over-feeding is especially injurious to mature cockerels.

The Use of a Free Range for Young Stock.—A flock of chickens will not roam continuously over any range for a complete day.

A little observation will indicate the number of hours each flock takes full advantage of the open run; and when this period has elapsed the birds should be returned to their deep litter and cage enclosure and the range should be devoted to another brood. Under such a system of management a given area of grass land will carry a much larger number of chickens.

SYSTEM II.

The following system of feeding and management is that employed in the Chicken Rearing Demonstration at Morden Hall, where the birds were intended for table purposes.

Rearing (Total period 12-16 weeks).

The chickens are left in the incubator until the twenty-second day, when they are transferred to the brooders. For the first two weeks, they remain in a portion of the rearing ground where they can be kept under constant observation. The brooders used at Morden Hall were each capable of accommodating 60 chickens up to the age of from 5 to 7 weeks.

Each brooder is placed in a run enclosed by wire netting 2 ft. high, supported by light stakes placed at intervals. These runs may conveniently measure 9 yds. by 40 yds., and are used for the chickens up to the age of seven weeks.

Each Sussex ark is placed in a run measuring 40 yds. by 20 yds., enclosed by wire netting 4 ft. high supported by stakes. Access is gained to the larger runs by an arrangement which permits of a short length of the wire netting between two posts being swung aside. When seven weeks old the chickens are transferred to these arks in lots of 40.

First Week.—During the first week the birds are provided at frequent intervals with as much food as they will clear up. The food consists of the following mixture (by weight):—

Wheat (cracked)	50 per cent.	Best meat meal	10 per cent.
Millet	15 "	Maize (cracked)	5 "
Canary seed ..	15 "	Rice	5 "

An unlimited supply of pure water is always provided, and grit is scattered on the floor of the brooder, and is constantly available throughout the whole process of rearing.

Second Week.—During the second week the birds are fed in the following way:—

At daybreak	Chick feed.
At 9 a.m.	Hard boiled egg.*
At 12.30 p.m.	Chick feed.
At 6 p.m. (or half-an-hour before sunset, according to the season)	Chick feed.

When the chickens are two weeks old they are moved to a brooder in the centre of the rearing field, and are confined for one day in a small wire run attached to the end of the brooder. This small run is then removed, and the chickens have access to the larger run in which the brooder is placed.

Third and Fourth Weeks.—Three tins containing chick feed, and fitted with wire guards to prevent the birds scratching out the food, are placed overnight in the brooder so that the first feed may be obtained at daybreak. These tins are removed when the birds are let out of the brooder, and a tin of groats is provided for them. At 9 a.m. soft food is given, consisting of biscuit meal with 10 per cent. of meat meal. The biscuit meal and meat meal are mixed with boiling water and dried off with equal parts of sifted barley meal and sharps. The mixture when prepared should be crumbly, the utmost care being taken to mix the ingredients thoroughly and avoid the use of "sloppy" food, which is a frequent cause of trouble. At the same time any groats which have not been cleared up are removed. At 1 p.m. soft food prepared as described above is given to the chickens. About 6 p.m., or earlier according to the season, the birds receive as much dry chick feed as they will eat.

Fifth, Sixth and Seventh Weeks.—At the beginning of the fifth week after hatching, and until they are seven weeks old, the chickens are fed as in the fourth week, but instead of the chick feed they receive a mixture consisting of 60 per cent. whole wheat and 40 per cent. chick feed.

When the chicks are seven weeks old they are moved to larger runs and are housed in Sussex arks, which are provided with slatted floors through which the manure falls. Wooden floors are placed on the ground below the arks in order that the manure may be collected and used.

Eighth to Sixteenth Week.—At 7 a.m. the birds receive a mixture composed of 1 lb. meat meal, 2 lb. biscuit meal and 1½ lb. bran.

This amount is soaked in 1¼ gal. of boiling water and dried off with a mixture composed of 2 lb. barley meal and 9 lb. fine sharps.

* In view of present conditions, bread and milk prepared as described above may be substituted.

This ration is given to the birds again at 1 p.m. The evening feed consists of 90 per cent. of whole wheat and 10 per cent. of cracked maize.

An alternative system of feeding which has proved advantageous is as follows:—

7.0 a.m.	..	Soft food (as described above)
10 30 a.m.	..	A half feed of mixed grain.
1.30 p.m.	..	A half feed of the soft food.
6.0 p.m.	..	As much mixed grain as the birds will eat.

Precautions for the Safety of Day-Old Chickens Received by Post or Rail.

1. Preparations should be made for the chickens before they are due to arrive. On arrival they must be kept warm, either by securing a quiet hen who will brood them, or by means either of an artificial rearer, or of the temporary substitute described below.

2. If it is decided to rear the chickens by natural means, select beforehand one, or if possible, two quiet hens which are thoroughly broody. Dust the birds with a reliable insect powder once or twice to free them from parasites. Prepare suitable nests* for them, set them on nest eggs and provide them regularly each morning with grain and water. Give two or three chickens to the hen *after dark* and carefully observe how she behaves. If she appears restless, jerks her head rapidly towards the nest at intervals and does not "croon" to the chickens, she should be rejected and another hen should be tried. If she croons to the chicks and appears quiet and settled, she is likely to prove satisfactory and 10 or 12 chicks may be entrusted to her.

3. If the chickens arrive in the daytime they must be kept warm until they can be given to the hen. Chickens do not require food for at least 48 hours after they are hatched, but they must have warmth.

4. *Artificial Brooders* are of various types but they all require reasonable care and intelligent management. The lamp of the brooder—if a lamp is used—must be refilled and the wick must be trimmed regularly. Good paraffin oil should be used, and no oil should be allowed to remain on the outside of the reservoir. Whatever type of brooder is selected for use, examine it thoroughly, and remove and replace the various parts so as to become familiar with the structure of the machine. Test the brooder thoroughly before the chickens arrive and work it in accordance with the maker's directions.

---

* *See* Leaflet No. 305.

5. *Other Means of Providing Heat.*—Procure a basket that will serve as a warm nest when filled with fine dry hay or grass; and, if possible, line it with a handful of downy feathers. The nest should be *just sufficiently large to hold the chickens.* Cover the top of the basket with a full-sized piece of flannel or blanket, gently pressed downwards into the hollow of the nest until it just touches the back of every chicken. Place a layer or two of soft paper into this hollow. If the weather or room be cold, place several layers of flannel and paper over the chicks. However you arrange matters place the basket with the chickens near a fire, or other steady source of heat. Then leave the birds for one hour, after which you should gently raise the nest cover to ascertain what the conditions are. If the birds are spread out, breathing quietly and show dry fluffy coats, all is well. Cover them as before. But if they are spread out, panting, with coats discoloured with streaks of moisture (appearing as if shrunken in size) the nest is too warm and the covering should be reduced. The larger the flock the less the cover necessary to produce proper and safe conditions in the nest. This improvised fireless brooder should only be adopted as a temporary measure until sitting hens that *will* accept the chickens are obtained.

6. Particulars of suitable methods of feeding will be found in Leaflet No. 114.

Safe Disposal of Hatching Eggs Received by Post or Rail.

1. Open the lid of the box with care; remove it gently; nails or tacks should never be used for securing the lid of the box.

2. Hatching eggs should not be enclosed in slips of paper twisted at the ends. The sudden twisting of the paper may injure the germ. Unpack each egg carefully.

3. Every egg should be spotlessly clean. If soiled, or coated with albumin as the result of breakages in transit, wash the shells with warm water, soap and washing soda, after which rinse them in clean cool water.

4. Then place the eggs in a cool place to rest for 24 hours before putting them under the hen or into an incubator.

5. If an incubator be used, run it steadily for 24 hours in accordance with the maker's directions before placing the eggs in it. The cold eggs will cause the temperature to fall. Do not interfere with the regulator for 24 hours after the machine is finally closed, but maintain the lamp flame exactly at its previous level. In using a machine for the first time, or when working a new machine, read the maker's directions carefully and follow them in detail.

6. If hens are used they should be quiet, *in good condition*, should be dusted with a reliable insect powder to free them from vermin, and should be tested on china eggs for 24 hours or more before the hatching eggs are placed beneath them.*

7. A quiet hen will take the eggs at any time, as one by one they are gently slipped beneath her, *but it is preferable always to set a hen at night.*

8. The number of eggs to place under a hen depends upon her size and the season of the year. An average hen will hatch 10 eggs more efficiently than 13 at any time; and it is safe practice to divide a valuable sitting between two, or even three, broody hens if they are available.†

9. Eggs, whether placed under hens or in an incubator, should be tested on the seventh day. In the case of eggs received under the Board's Egg Distribution Scheme, *infertile* eggs alone will be replaced provided that they bear the official stamp, and are returned to the Station Holder carriage paid.

Notes on Feeding Stuffs in February: *From the Animal Nutrition Institute, Cambridge University.*

THE chief feature of this month's prices, besides the general all-round increase, is the great variation in price between the different markets. The price of maize meal, for instance, is £14 per ton in London and only £12 7*s*. 6*d*. in Liverpool. This is not the only case. Differences of £1 per ton between markets are quite general. The cause, no doubt, is the increasing difficulty of railway transport. With such differences between markets, it is misleading to average the prices per food unit, so a separate list is given of prices per food unit at each market. To avoid repetition the prices per food unit have been removed from the large table.

Table I., therefore, gives the number of food units per ton and the prices per ton at the four great markets. Tables II., III., IV. and V. give in order the prices per food unit on the London, Liverpool, Hull, and Bristol markets, respectively. Table VI. gives the average prices per food unit at all the four markets. Table VII. gives particulars of composition and feeding value, as in former notes.

The writers have to thank Professor Crowther, of Leeds University, for sending them figures which have enabled them

* *See also* Leaflet No. 305. † Particulars of suitable methods of feeding will be found in Leaflet No. 114.

to revise their estimate of the composition and feeding value of palm-nut kernel cake. Other correspondents also deserve thanks for useful information on several points.

TABLE I.

Feeding Stuff.	Digestible Food Units.	Approximate prices per ton at the end of January.			
		London.	Liverpool.	Hull.	Bristol.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.
Soya Bean Cake	122·3	—	12 5 0	11 10 0	—
Decorticated Cotton Cake	126·3	12 13 9	13 2 6	—	—
Indian Linseed Cake ..	123·1	13 6 3	13 0 0	—	—
English Linseed Cake ..	120·1	13 13 9	13 15 0	13 2 6	13 12 6
Bombay Cotton Cake ..	65·3	10 7 6	10 10 0	10 0 0	—
Egyptian Cotton Cake ..	71·9	10 10 0	11 0 0	10 10 0	10 12 6
Coconut Cake	102·6	10 17 6	10 15 0	—	—
Palm-nut Kernel Cake ..	90·5	—	9 10 0	—	9 2 6
Ground-nut Cake	145·2	*12 0 0	10 15 0	12 5 0	12 10 0
English Beans (new) ..	99·5	11 13 8	13 10 8	12 4 3	12 0 0
,, ,, (old) ..		12 12 8			
Chinese Beans	101·2	11 18 0	—	—	—
English Maple Peas ..	97·2	14 13 4	—	14 17 9	—
English Dun Peas ..	97·2	13 0 0	—	12 4 5	—
Calcutta White Peas ..	97·5	17 2 3	—	17 15 7	—
American Maize	93·8	13 1 4	12 0 10	—	—
Argentine Maize	94·2	12 5 0	11 13 4	11 12 2	12 1 6
Maize Meal	86·5	14 0 0	12 7 6	13 2 6	12 12 6
Maize Gluten Feed ..	121·6	12 0 0	—	—	12 7 6
Maize Germ Meal ..	99·2	13 0 0	12 10 0	—	12 12 6
English Feeding Barley ..	83·0	14 0 0	—	14 11 2	—
English Oats	75·4	12 0 0	12 8 11	12 0 0	11 13 4
Argentine Oats	75·4	12 10 6	11 16 5	—	12 3 2
Malt Culms	69·9	6 15 0	9 0 0	7 0 0	8 10 0
Brewers' Grains (dried) ..	84·5	†8 15 0	—	8 15 0	9 12 6
,, ,, (wet) ..	21·1	§1 7 0	—	1 10 0	—
Egyptian Rice Meal ..	78·7	—	—	10 0 0	9 15 0
Burmese Rice Meal ..	78·7	—	10 5 0	—	—
Wheat Middlings	93·4	10 5 0	—	10 5 0	11 15 0
Wheat Sharps	86·3	10 0 0	11 15 0	10 15 0	10 17 6
Wheat Pollards	81·9	—	10 5 0	—	—
Wheat Bran	77·5	9 10 0	10 5 0	9 15 0	9 7 6
Wheat Bran (broad) ..	79·9	10 0 0	11 0 0	10 5 0	9 17 6
Feeding Treacle	60·0	9 18 9	10 12 6	—	—
Linseed	153·5	20 11 11	26 0 0	22 17 8	20 17 4
,, Oil	250·0	‡44 0 0	‡48 0 0	41 15 0	49 15 7
Egyptian Cotton Seed ..	108·6	14 0 0	—	15 12 6	—
Brazilian ,, ,, ..	107·6	—	—	—	—
Cotton Seed Oil	250·0	—	‡55 0 0	—	—

* 2nd grade, £11 10*s.*
‡ Includes barrels.
† Porter grains (London), £8 7*s.* 6*d.*
§ Porter grains (London), £1 4*s.* 6*d.*

We have recently analysed another sample of Soycot cake and found it to contain 100 digestible food units per ton, which is 12 units more than the sample we analysed in December. The composition of the cake has evidently been changed so

as to give a higher analysis, probably by increasing the proportion of soya bean and decreasing the proportion of cotton seed.

Since last month the prices of all feeding stuffs shown in the list have risen, for the most part very sharply, the rises varying from ½*d.* to 6¼*d.* per food unit. The rise is most pronounced in linseed, linseed oil, cotton seed, cotton cake, maize and maize products, feeding barley, oats, Calcutta white peas, Burmese rice meal and feeding treacle. Ground-nut cake and coconut cake have also advanced considerably. Bran and pollards are much dearer, but the prices of other wheat offals are little higher than last month.

TABLE II.

PRICES PER FOOD UNIT. LONDON.

	s.	*d.*		*s.*	*d.*
Brewers' grains (wet) ..	1	3¼	Egyptian cotton seed ..	2	7
Ground-nut cake ..	1	7¾	Argentine maize ..	2	7¼
Malt culms	1	11¼	Maize germ meal ..	2	7½
Maize gluten feed ..	1	11¾	English dun peas ..	2	8
Decorticated cotton cake	2	0	Linseed	2	8¼
Brewers' grains (dried) ..	2	1	American maize.. ..	2	9½
Coconut cake	2	1½	Egyptian cotton cake ..	2	11
Indian linseed cake ..	2	2	English maple peas ..	3	0¼
Wheat middlings ..	2	2½	Bombay cotton cake ..	3	2
English linseed cake ..	2	3¼	English oats	3	2¼
Wheat sharps	2	3¾	Maize meal	3	2¾
English beans (new) ..	2	4¼	Feeding treacle	3	3¾
Chinese beans	2	4¼	Argentine oats	3	4
Wheat bran	2	5½	English feeding barley ..	3	4½
Wheat bran (broad) ..	2	6	Calcutta white peas ..	3	6¼
English beans (old) ..	2	6½	*Linseed oil*	3	6¼

TABLE III.

PRICES PER FOOD UNIT. LIVERPOOL.

	s.	*d.*		*s.*	*d.*
Ground-nut cake ..	1	5¾	Wheat bran	2	7¾
Soya bean cake	2	0	English beans	2	8¾
Decorticated cotton cake	2	1	Wheat sharps	2	8¾
Indian linseed cake ..	2	1¼	Wheat bran (broad) ..	2	9
Coconut cake	2	1¼	Maize meal	2	10¼
Palm-nut kernel cake ..	2	1¼	Egyptian cotton cake ..	3	0¾
English linseed cake ..	2	3½	Argentine oats	3	1¾
Argentine maize	2	5¾	Bombay cotton cake ..	3	2½
Wheat pollards	2	6	English oats	3	3½
Maize germ meal ..	2	6¼	Linseed	3	4¾
American maize	2	6¾	Feeding treacle	3	6½
Malt culms	2	7	Linseed oil	3	10
Burmese rice meal ..	2	7¼	Cotton seed oil	4	4¾

TABLE IV.

PRICES PER FOOD UNIT. HULL.

	s.	d.		s.	d.
Brewers' grains (wet) ..	1	5	Egyptian rice meal ..	2	6½
Ground-nut cake ..	1	8¼	Wheat bran (broad) ..	2	6¾
Soya bean cake	1	10½	Egyptian cotton seed ..	2	10½
Malt culms	2	0	Egyptian cotton cake ..	2	11
Brewers' grains (dried) ..	2	1	Linseed	2	11¾
English linseed cake ..	2	2¼	Maize meal	3	0½
Wheat middlings ..	2	2½	English maple peas ..	3	0¾
English beans	2	5½	Bombay cotton cake ..	3	0¾
Argentine maize	2	5½	English oats	3	2¼
Wheat sharps	2	6	Linseed oil	3	4
English dun peas ..	2	6¼	English feeding barley ..	3	6
Wheat bran	2	6¼	Calcutta white peas ..	3	7¾

TABLE V.

PRICES PER FOOD UNIT. BRISTOL.

	s.	d.		s.	d.
Ground-nut cake ..	1	8¾	Wheat sharps	2	6
Palm-nut kernel cake ..	2	0¼	Wheat middlings ..	2	6¼
Maize gluten feed ..	2	0½	Maize germ meal ..	2	6½
English linseed cake ..	2	3¼	Argentine maize ..	2	6¾
Brewers' grains (dried) ..	2	3¼	Linseed	2	8¾
English beans	2	5	Maize meal	2	11
Wheat bran	2	5	Egyptian cotton cake ..	2	11½
Malt culms	2	5¼	English oats	3	1¼
Wheat bran (broad) ..	2	5½	Argentine oats	3	2¾
Egyptian rice meal ..	2	5¾	Linseed oil	3	11¾

TABLE VI.

AVERAGE PRICES PER FOOD UNIT.

	s.	d.		s.	d.
Brewers' grains (wet) ..	1	4¼	Maize germ meal ..	2	6¾
Ground-nut cake ..	1	7½	Wheat bran (broad) ..	2	6¾
Soya bean cake	1	11¼	English dun peas ..	2	7
Maize gluten feed ..	2	0	Burmese rice meal ..	2	7¼
Decorticated cotton cake	2	0½	American maize	2	8
Palm-nut kernel cake ..	2	0¾	Egyptian cotton seed ..	2	8¾
Coconut cake	2	1¼	Linseed	2	11¼
Indian linseed cake ..	2	1½	Egyptian cotton cake ..	2	11½
Brewers' grains (dried) ..	2	1¾	Maize meal	3	0
Malt culms	2	2¾	English maple peas ..	3	0½
English linseed cake ..	2	3	Bombay cotton cake ..	3	1¾
Wheat middlings ..	2	3¾	English oats	3	2¼
Chinese beans	2	4¼	Argentine oats	3	2¾
English beans	2	6	Feeding treacle	3	5
Egyptian rice meal ..	2	6	English feeding barley ..	3	5¼
Wheat sharps	2	6	Calcutta white peas ..	3	7
Wheat pollards	2	6	Linseed oil	3	8
Argentine maize	2	6¼	Cotton seed oil	4	4¾
Wheat bran	2	6¼			

TABLE VII.

(1) Name of Feeding Stuff.	(2) Nutritive Ratio.	(3) Per cent. digestible. Protein.	(4) Fat.	(5) Carbo-hydrates and Fibre.	(6) Starch equiv. per 100 lb.	(7) Linseed Cake equiv. per 100 lb.
Foods Rich in both Protein and Oil or Fat.						
Ground-nut cake	1 : 0·8	45·2	6·3	21·1	77·5	102
Soya bean cake	1 : 1·1	34·0	6·5	21·0	66·7	88
Decort. cotton cake ..	1 : 1·2	34·0	8·5	20·0	71·0	93
Linseed cake, Indian ..	1 : 1·9	27·8	9·3	30·1	77·1	101
Linseed cake, English ..	1 : 2·0	26·7	9·3	30·1	76·0	100
Cotton cake, Egyptian ..	1 : 2·1	15·5	5·3	20·0	40·0	53
Cotton cake, Bombay ..	1 : 2·5	13·1	4·4	21·5	37·6	49
Maize gluten feed	1 : 3·0	20·4	8·8	48·4	87·4	115
Brewers' grains, dried ..	1 : 3·5	14·1	6·6	32·7	50·3	66
Coconut cake	1 : 3·8	16·3	8·2	41·4	76·5	101
Palm-nut kernel cake ..	1 : 4·6	12·5	7·7	39·0	69·5	90
Linseed	1 : 5·9	18·1	34·7	20·1	119·2	157
Fairly Rich in Protein, Rich in Oil.						
Maize germ meal	1 : 8·5	9·0	6·2	61·2	81·0	107
Rice meal	1 : 9·4	6·8	10·2	38·2	68·4	90
Rich in Protein, Poor in Oil.						
Peas, Calcutta white ..	1 : 2·1	23·3	1·1	45·9	66·9	88
Beans, English	1 : 2·6	19·3	1·2	48·2	67·0	88
Beans, Chinese	1 : 2·6	19·6	1·7	47·9	67·0	88
Peas, English maple ..	1 : 3·1	17·0	1·0	50·0	70·0	92
Brewers' grains, wet ..	1 : 3·5	3·5	1·5	8·6	12·7	17
Malt culms	1 : 3·6	11·4	1·1	38·6	38·7	51
Cereals, Rich in Starch, not Rich in Protein or Oil.						
Barley, feeding	1 : 8·0	8·0	2·1	57·8	67·9	89
Oats, English	1 : 8·0	7·2	4·0	47·4	59·7	79
Oats, Argentine	1 : 8·0	7·2	4·0	47·4	59·7	79
Maize, American	1 : 11·5	6·7	4·5	65·8	81·0	107
Maize, Argentine	1 : 11·3	6·8	4·5	65·8	83·5	110
Maize meal	1 : 13·0	5·5	3·5	63·9	77·8	102
Wheat middlings	*1 : 5·3*	*12·0*	*3·0*	*56·0*	*59·1*	*78*
Wheat sharps	1 : 5·0	12·0	4·0	50·0	58·4	77
Wheat pollards	1 : 5·3	11·6	3·5	53·0	54·1	71
Wheat bran	1 : 4·7	11·3	3·0	45·0	49·7	65
Wheat bran, broad ..	1 : 4·7	11·3	3·0	45·4	48·1	63

Suggested Rations for February.—*For Horses.*—The rations which have been recommended in former notes contained a considerable proportion of maize. At the time when they were worked out, maize was one of the cheapest foods on the market. This is no longer the case; indeed, maize has recently become very dear, and is not an economical food to buy at present prices. As a matter of fact, all starchy foods are comparatively dear at the present time, and it is difficult to work out a suitable mixture for horses which contains enough carbohydrates and is reasonable in price. The following mixture is suggested:—

Crushed beans ..	1 part.	Bran, pollards, sharps or middlings, whichever is cheapest locally	1 part.
Dried brewers' grains	1 ,,		
Rice meal	1 ,,		

This mixture contains rather too much protein and not quite enough starchy materials for horses, but this can readily be corrected by giving rather a smaller ration and supplementing it with about a stone per head per day of cut roots. Used in this way it should give good results with horses at ordinary farm work.

For Milch Cows.—For a cow weighing 10 cwt., and giving 2 gal. of milk per day, the following ration is suggested, in addition to an ordinary ration of roots, hay, and straw:—3 lb. of bran and 2 lb. of one of the following mixtures of concentrated foods:—

I. Maize gluten feed, dried grains, coconut cake. and ground-nut cake, 1 part of each.
II. Decorticated cotton cake, 3 parts, rice meal, 2 parts.
III. Ground-nut cake, coconut cake, and rice meal, 1 part of each.
IV. Ground-nut cake, palm-nut kernel cake, coconut cake, and maize gluten feed, 1 part of each.

For each extra gallon of milk 2 lb. of concentrated food, I., II., III., or IV. above, should be added to the ration. The whole ration should also be increased or diminished for cows above or below 10 cwt. live-weight.

For Fattening Bullocks.—For fattening cattle, where roots are plentiful, the ration recommended consists of all the roots and straw the animals will eat supplemented by 3 lb. per head per day of ground-nut cake, which might be increased to 5 lb. as fattening progresses. Where roots are plentiful this ration cannot be improved upon at present prices. The writers have tried it at the Norfolk Agricultural Station with marked success. For the first 2 months, 21 bullocks, of an average live-weight of about 10 cwt., have made live-weight increases of about 20 lb. per head per week.

Where the amount of roots is limited, or the quality of the roots such that the animals will not eat more than about 56 lb. per head per day, it will pay to give more concentrated food. Ground-nut cake, however, contains too much protein to use alone in larger quantity than from 3 to 5 lb. per head per day. Starchy foods suitable for mixing with it are now so very dear that it will pay better to use palm-nut kernel cake alone up to 7 or 8 lb. per head per day, or a mixture of palm-nut kernel cake, decorticated cotton cake, and coconut cake.

For Ewes Suckling on Roots.—The writers have heard good accounts of the following mixture which was suggested last month:—

Ground-nut cake ..	2 parts.	Mixed home-grown corn, crushed ..	3 parts.

Cotton cake is now so dear that the writers do not hesitate to recommend this mixture in place of the safer and better-known mixtures advised last month. Cases are known where it has been used with success.

It is advised that the ground-nut cake should be withheld for the first few days after lambing, and then introduced gradually.

The writers have heard of digestive trouble arising from ewes eating from troughs containing the dusty remains of foods with whose properties shepherds are not yet familiar. Many unfamiliar foods are now being used. Some of them leave a dusty residue in the troughs, which gets wet and ferments. Such fermented remains have been found to cause trouble. Sheep owners are, therefore, reminded that it is important to see to the thorough cleanliness of sheep troughs used for foods which are liable to leave a dusty residue.

The writers have been asked about the use of palm-nut kernel cake for sheep, more especially for suckling ewes. Having no personal experience of its use they would be greatly obliged if any reader who has used it for sheep would be good enough to give them the benefit of his experience.

For Lambs and Other Young Stock.—In these notes for November a mixture of 1 part of linseed ground together with 5 parts of maize was recommended as a substitute for linseed cake for young stock. Since that date maize has risen so considerably in price that such a mixture has become more expensive than the linseed cake as a substitute for which it was designed. It is advisable, therefore, to return to linseed cake, which should be used in a mixture with an equal weight of bran, dried brewers' grains, or malt culms.

For Fattening Pigs.—Pigs require foods containing a large proportion of starchy materials. At the present time all foods of this kind are very dear. Barley meal, which is, on the whole, the best food for pigs, costs 3*s.* 6*d.* per food unit, a price which is practically prohibitive. Middlings, sharps, pollards, and rice meal are about 1*s.* per unit cheaper. Where they are available, chats or other unsaleable potatoes, cooked before use, should be used. Working with small quantities, about 5 cwt. of coal will cook 1 ton of potatoes. In reckoning quantities for rations, 4 lb. of potatoes may be taken to be about equal to 1 lb. of barley meal. For fattening stores of about 6 to 8 months old, a weighed quantity of potatoes should be cooked, the water poured away, and the potatoes mashed and mixed with an equal weight of middlings, sharps, pollards, or rice meal, previously

tirred up with enough water to make a suitable gruel so that ne cooked potatoes will thicken it to about the proper consistency. Pigs will do well on this until about half fat. For inishing, it is advisable to use a mixture of 4 parts of one or ther of the above meals with 1 part of bean meal, which is nixed with the cooked potatoes as before.

For Fattening Newly Weaned Pigs, to come out as "Lononers" or bacon hogs at 7 months. Two parts of potatoes are 'eighed out and cooked. The cooked potatoes are then mashed nd mixed with 6 parts by weight of pollards previously stirred nto a suitable gruel with water. Just before feeding, 1 part, by 'eight, of finely-ground linseed cake is scattered on to the gruel nd stirred in. The writers have used this method of fattening oung pigs with success.

'otes on Fertilisers in February:
'rom the Rothamsted 'xperimental Station.

THE two great manurial needs of crops at the present time re nitrogen and phosphates: nitrogen to make good the loss of nitrates from the soil, and phosphates to encourage root development, especially on the heavier soils, and to give the plant a vigorous start once it begins growing. These would be needed at any time under milar weather conditions, but they are particularly necessary ist now that additional food supplies must be raised in the ountry. A proper balance must, however, be maintained etween them. Farmers who have tried to increase their corn ops and have "done" their land better than usual by giving ore ammonia or more dung, or by feeding more cake than sual, should balance this additional nitrogen by a dressing of iperphosphate (or, in certain cases, basic slag). This prevents inkness, and hastens ripening, besides improving the quality the grain.

Nitrogenous Manures.—*Nitrate of Lime.*—This is offered at Hull 15*s.* per unit of nitrogen, and farmers who are able to obtain it this price must consider themselves fortunate. In general tion it resembles nitrate of soda, and experiments at a number centres have shown its value as a spring dressing for all crops. contains approximately the same percentage of nitrogen as itrate of soda, but in present circumstances it may be used in rger quantities, and it still comes out a cheap manure. The der samples usually tended to become sticky and to store adly, but this difficulty is being steadily overcome. It appears be free from the disadvantage of making heavy soils work adly.

Calcium Cyanamide, better known as Nitrolim.—This is even lower in price at Hull than nitrate of lime, and at each place where quotations are given it is the cheapest quick-acting nitrogenous manure obtainable. It has considerably improved during the last few years, and the granular form appears to be very promising. It must go on early; late sowing has on several occasions led to bad results; but at any time during this month or next it may be used to advantage.

Sulphate of Ammonia.—This manure ought to be used more freely for cereals. Farmers have long used soot as a top-dressing for wheat. Sulphate of ammonia is the essential fertilising constituent of soot in a concentrated form, and the Rothamsted and other experiments have shown that it is very effective.

Nitrate of Soda.—Nitrate of soda is very high in price, but, even at the present figure, will still prove useful for spring dressings, especially where plants are standing still and suffering from the effects of pests. The soda is of value at the present time as it both liberates potash from the soil and helps to economise the use of potash in the plant.

Organic Manures.—War conditions have brought on to the market a number of organic materials of fertilising value. Some are waste products of manufacturers rendered specially busy by the war; others are fertilisers which used to go to the Continent, but are now kept in this country; some of them pass under the name of guano. Fertiliser manufacturers take up a considerable amount, but farmers also may get an opportunity of obtaining them. *They should never be purchased on a mere* inspection of the sample. However good the material may look, and however strongly it may smell, a sample should always be drawn and be analysed by the county authority. The trouble and expense are only small, but the value to the farmer is considerable, as he is at once enabled to judge whether or not the manure is worth the money asked.

Phosphatic Manures.—The chief point calling for comment is the high price of dissolved bones. So far as experiments go the soluble phosphate in dissolved bones is no better than in superphosphate, and there is nothing to justify the higher prices asked this month.

Bone meal acts well in many cases, and may be substituted, in the case of arable crops, for basic slag or superphosphate, where deliveries of these cannot be obtained in time. Steamed bone flour is in a finer state than the meal, but no precise experiments have been made to compare them, so that it is impossible

to assert that one is superior to the other. There is no reason to suppose that the nitrogen in steamed bone flour is worth more to the farmer than that in the meal, and nothing to show why he should be asked to pay 2*s.* or 2*s.* 6*d.* per unit more for it, as he is at some places. (See *Unit Prices*, p. 1159.)

Potash Manures.—The need for potash is sure to be felt sooner or later; meanwhile it can be met:—

1. By saving all the ashes from the burning of hedge cleanings and trimmings, dust and other refuse of threshing operations;
2. By applying lime to the soil; and
3. By the use of salt; or of sulphate of soda, which is obtained as a by-product in the manufacture of certain acids used for munitions. It must, however, be analysed before use and *certified free from acidity*. Some samples contain potash: one recently examined at Rothamsted contained as much as 23 per cent., and, as it had been obtained for very little, was a great bargain for the farmer who had bought it.

Suggestions.—In view of the difficulties of transport and of labour it is necessary to get well forward with the arrangements for the spring dressings. The general rules are:—

Sulphate of ammonia, nitrolim and soot can safely go on *early* in the spring.

Nitrate of soda and nitrate of lime can safely be left till later.

Organic manures, such as fish guano, should go on early, but can be harrowed in. Shoddy, however, must be ploughed in.

Bone meal and bone flour should go on early.

Basic slag can be used a little later.

Superphosphate and dissolved bones can go on rather later still, and can be applied as top-dressings for winter corn.

Unit Prices of Artificial Manures in February.

THE statement on p. 1159 shows the cost to the purchaser of 1 per cent. per ton of nitrogen, soluble and insoluble phosphates, and potash derived from various sources, at certain ports and manufacturing centres, for February, 1916.

NOTE.—These unit prices are based on the *probable* retail cash prices in bags f.o.r. for quantities of not less than 2 tons of the manures mentioned at the ports and places specified, but it should be borne in mind that market prices are fluctuating considerably at the present time. The prices are published by the Board of Agriculture and Fisheries for use in comparing the commercial values of artificial manures. They may also be used as a guide to the probable price per ton of any of the manures mentioned if the unit prices of the

	London.	King's Lynn.	Hull.	Newcastle.	Silloth.	Liverpool.	Widnes.	Newport.	Bristol.	Plymouth.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Nitrogen from:										
Sulphate of Ammonia pure 95%	—	—	17 3	16 3	—	—	—	17 6	—	—
Sulphate of Ammonia pure 93%	—	—	17 2½	—	—	18 9	18 9	—	17 8½	17 11½
Calcium Cyanamide ..	—	—	14 6	15 9½	—	14 6	—	16 1½	—	16 1½
Nitrate of Soda pure 95%	—	—	20 11½	—	—	21 10½	22 7	—	21 9½	—
Nitrate of Soda pure 90%	21 11	—	22 0	—	22 0	—	—	22 4	—	21 8
Nitrate of Lime ..	—	—	15 0	—	—	—	—	—	—	—
Soluble Phosphates from:										
Superphosphate 35%	2 8½	—	2 8	3 0	2 10½	2 9½	2 8½	2 9½	2 9½	2 9½
" 33%	2 8½	—	2 9	3 0½	—	2 0½	2 8½	2 9½	2 9½	2 9½
" 30%	2 9½	—	2 10½	3 2	3 0	2 10½	2 9½	2 10½	2 10½	2 10½
" 26%	3 0½	—	3 1	3 6	—	3 2	3 1	3 2	3 2	3 2
Dissolved Bones	3 10	—	3 7	—	3 9	4 2	4 0½	3 10½	4 1½	3 11
Allowed for Nitrogen	*21 5½*	—	*20 2*	—	*20 11½*	*23 3*	*22 6½*	*21 10*	*23 1*	*22 0*
Allowed for Insol. Phos.	*2 2*	—	*2 0½*	—	*2 1½*	*2 4*	*2 3*	*2 2½*	*2 4*	*2 2½*
Insoluble Phosphates (Citric Soluble) from:										
Basic Slag	*2 7*	—	*2 0*	—	—	*2 0½*	—	—	*2 1½*	*2 7*
Insoluble Phosphates from:										
Basic Slag	—	—	1 11½	1 7½	—	—	—	—	—	—
Bone Meal	1 10½	—	1 9½	1 11	2 2	1 10½	1 10	1 7½	1 8½	1 11
Allowed for Nitrogen	*18 8*	—	*17 7*	*19 0*	*21 3½*	*18 7½*	*18 4½*	*16 2*	*17 0½*	*18 11*
Steamed Bone Flour ..	1 11½	—	2 0½	2 1	—	—	—	1 8	1 11	—
Allowed for Nitrogen	*19 4*	—	*20 2*	*20 7*	—	—	—	*16 6*	*19 1½*	—
Potash					No quotations.					

constituents of the manure are multiplied by the percentages of the constituents found in it, and due allowance is made for the difference between cash prices and credit prices, and for cost of carriage from the nearest centre to the place where it is delivered to the purchaser. If used in connection with the valuation of a compound manure regard must be had to the sources of the constituents, and a reasonable sum must be added for mixing, disintegrating and rebagging the ingredients, bags, and loss of weight.

Agricultural Exports in 1915.*

The value of the agricultural articles of British production and manufacture exported amounts in the aggregate to a considerable sum, although, taken individually, such articles do not usually represent a very extensive trade. The unusual conditions brought about by the European war have, doubtless, affected the exports of most of the commodities in 1915. The information available for the past year is summarised in the tables on p. 1161. The various commodities included under the heading of grain and flour represent a total of £3,785,052, while meat of all kinds, including living animals (chiefly cattle) for food, bacon, hams, poultry and game, accounts for £1,344,071. Wool from British flocks was exported to the value of £2,026,463, while hides and undressed skins accounted for £899,150, a great decrease compared with 1914 and 1913.

Three items of importance, viz., manures, cakes, and agricultural machinery, are included in the table, though they are not agricultural products. In the case of manures, 541,931 tons were sent from this country, representing a value of £4,812,008; over one-half of this, viz., 294,308 tons, was sulphate of ammonia, while the balance was made up of 68,735 tons of superphosphate, 117,487 tons of basic slag, and 61,401 tons of other kinds of artificial manures.

As regards oil-seed cake, the exports of this feeding stuff have steadily declined from 175,422 tons in 1910 to 30,125 tons in 1915.

A very large decrease in the exports of agricultural machinery took place in 1915, and the total value of the trade fell to £457,030 compared with £2,313,671 in 1914, and £2,989,186 in 1913.

In normal times perhaps the most interesting item in the export trade, from an agricultural point of view, is that which shows the sales of breeding animals to the Colonies and foreign

* The exports include goods bought in the United Kingdom by, or on behalf of, the Governments of the Allies, but do not include goods taken from British Government Stores and Depots, or goods bought by His Majesty's Government and shipped on Government vessels.

EXPORTS.

Description.		1914.	1915.
Grain and flour	£	3,095,080	3,785,052
Meat (including animals for food)	£	1,139,362	1,344,071
Wool	lb.	38,458,000	32,002,000
	£	2,294,638	2,026,463
Hides and undressed skins ..	£	1,483,108	899,150
Manures	tons	639,115	541,931
	£	4,886,474	4,812,008
Oil-seed Cake	tons	41,566	30,125
	£	265,827	236,055
Agricultural machinery (prime movers except electrical)	£	1,157,661	180,311
,, (not prime movers or electrical)	£	1,156,010	276,719

Description.	Quantity.		Value.	
	1914.	1915.	1914.	1915.
ANIMALS, LIVING—FOR BREEDING:	Number.	Number.	£	£
Cattle: To United States of America	587	373	31,389	12,774
,, Uruguay ..	192	209	16,631	14,549
,, Argentine Republic	605	845	69,232	110,101
,, Australia.. ..	85	54	8,996	4,312
,, Canada	—	187	—	6,060
,, Other Countries..	1,016	438	44,434	27,566
Total	2,485	2,106	170,682	175,362
Sheep and Lambs: To Germany.. ..	316	—	2,926	—
,, United States of America	722	199	6,664	1,409
,, Uruguay ..	738	321	11,640	4,958
,, Argentine Republic	233	1,789	2,696	35,741
,, Australia.. ..	48	85	2,436	1,471
,, New Zealand ..	—	45	—	1,474
,, Canada	427	140	2,748	808
,, Other Countries..	540	454	6,875	6,190
Total	3,024	3,033	35,985	52,051
Swine: To Argentine Republic	3	12	15	185
,, Canada	—	2	—	27
,, Other Countries..	411	114	5,384	1,191
Total	414	128	5,399	1,403
HORSES:				
To Netherlands ..	10,392	9	87,596	615
,, *Belgium*	19,205	—	363,486	—
,, France	1,299	344	102,219	62,391
,, Other Countries..	6,810	1,192	511,721	256,998
Total	37,706	1,545	1,065,022	320,004
ANIMALS OF OTHER KINDS—Not for food	32,336	17,924	48,561	27,882

countries. Particulars of this trade for the past two years are given in the table on p. 1161. During the latter part of 1914 and throughout the whole of 1915 the trade was adversely affected by the war to a large extent.

In 1915, despite the fact that a smaller number of cattle were exported from this country than in 1914, the total value was slightly higher in the former year than in the latter. In the case of sheep and lambs, also, although the number exported was almost identical in both years, the value in 1915 amounted to one-half as much again as that of 1914.

As regards the export of horses. the trade in 1915 was to a great extent suspended, the number of animals being 1,545, against 37,706 in 1914 and 68,632 in 1913. Such trade as was carried on, however, was apparently in animals of considerable value, the average price per horse in 1915 being about £207, compared with £28 in 1914 and £26 in 1913. It may be of interest to mention that the average prices paid per horse in 1915 were: by Holland £68, by France £181, and by "other countries" £216.

Destruction of Farm Vermin.*

IN view of the necessity for maintaining the supply of *home-grown food, efforts must be made to reduce the* damage done by rabbits, rats, sparrows, rooks, wood pigeons, and other forms of farm vermin.

The principal methods of destroying the more troublesome forms of vermin are indicated in the present article, while further information as to the best methods of dealing with house sparrows and rats is given in Leaflets Nos. 84 and 244 respectively.

Rats.—Rats are responsible for more waste on many farms than any other kind of farm vermin. They will not remain or increase in places where food is not easily procured, and therefore, so far as possible, all buildings and receptacles for food should be made rat-proof, and waste food should not be left in stables, cow-houses or poultry runs. Garbage and refuse of all kinds which might harbour rats or provide food for them should be burnt or otherwise disposed of. When farm buildings are properly looked after and cats are kept, rats seldom increase rapidly.

* This article is a reprint of Special Leaflet No. 52, recently issued. Separate copies of the leaflet will therefore not be sent to subscribers to the *Journal* unless specially applied for.

When rats are present in numbers, systematic and persistent efforts should be made to destroy them. Three main methods may be employed :—

(1) *Hunting.*—The rats may be ferreted out and killed with dogs, sticks and the shot gun. When corn ricks are thrashed a special endeavour should be made to kill every rat turned out. The rats may be caught with greater certainty if the ricks are surrounded with galvanised iron sheeting or wire netting, 4 ft. in height, sloping towards the ricks.

(2) *Traps.*—In addition to the spring trap, the wire trap on the eel-basket principle, the sunk pit or well trap, and the large barrel trap with slit paper or hinged wooden cover may at times be found effective. For a description of these traps reference should be made to Leaflet No. 244 (*The Destruction of Rats*).

(3) *Poisons and Fumigants.*—Rat poisons are to be obtained from most chemists, and are likely to be effective if the appearance and form of the bait are varied at intervals. The chief objection to the use of poisons is the possibility of injury to other animals. According to a note in the *Scottish Farmer* (2nd October, 1915), the following method has been found effective and safe :—Shallow trenches are dug about 12 to 14 in. long and 4 in. wide, and covered over with a board, straw or sticks. A mixture made up of 1 oz. of the coarsest moist sugar with 4 oz. of dry flour, oatmeal or barley meal is then left in the trench each night until the rats eat it readily. The process is omitted for one night, and the following night 1 oz. of finely powdered barium carbonate is thoroughly incorporated with the mixture. As the whole mixture is in a dry state the rats cannot carry it away, but eat it on the spot. *See also* Leaflet No. 244.

In the case of burrows in the open, fumigation with carbon bisulphide may be employed. A large wad of cotton wool, rag, or similar absorptive material should be soaked with the liquid and at once inserted in one of the main burrows, and the outlets and inlets closed up. Care should be taken in using the bisulphide, as it is both poisonous and highly inflammable, and no light of any kind should be brought near it. As the bisulphide is heavier than air the wad should be inserted at the highest point of the burrows, so that the vapour moves steadily downwards.

Mice.—Mice often do considerable damage in gardens by destroying peas and other seeds. To protect peas against the attacks of mice the seed should be steeped in a solution of

bitter aloes (1 oz. to 2 quarts of water) and allowed to remain for a night before sowing. Ordinary baited mouse traps placed near the rows will also be found useful.

Sparrows.—In the case of many birds there is room for doubt as to their true economic position in relation to agriculture, but in the case of the sparrow there is none. Sparrows do most damage during the few weeks before harvest. Later on they live mainly round dwelling houses, taking grain from the stacks and poultry yards and various waste material. Their depredations, however, are not confined to grain crops, and they do much damage among garden crops.

To reduce the numbers of sparrows their eggs and nests should be destroyed in the breeding season. On dark nights the birds may be driven into nets from their roosting places in ricks, hedges, or ivy-clad houses. Shooting with small shot during frost or snow, when the birds are readily attracted by grain, is useful, while combined action of the kind indicated in Leaflet No. 84 is especially valuable.

Rooks and Larks.—These birds often do much damage to sprouting autumn-sown corn, especially wheat. Where they are unusually troublesome some farmers adopt the plan of stringing whole fields with cotton. Treating the grain with preparations of tar and petroleum (a pint of coal tar thinned down with paraffin to 6 bush. of seed afterwards dried with powdered lime) has met with success in some cases, and it is claimed that naphthalene mixed with sawdust and distributed over the surface of a newly-sown field will keep all birds away for some time.

The following plan is considered by some to be effective in the case of the rook: immediately the seed is sown and before the rooks have discovered it, the carcass of a rook is torn to pieces and distributed over the field (a few dead rooks will be sufficient for a considerable area). As a general measure to keep down the numbers of rooks, rookeries may be raided at nesting time, but as the nestlings are largely fed on insect food it would be well not to destroy the rooks until the young are nearly ready to fly.

Wood Pigeons. — In many districts wood pigeons prove a most troublesome pest to the farmer and take large quantities of grain, cabbages, turnips, clover leaves, etc. Wood pigeons may be kept down by shooting and trapping. The best time for shooting is at sunset and before dusk when the birds are coming back to roost, or they may be shot at

their feeding places. The shooter should be in some pı pared shelter such as a conical hut of branches or a cover shelter in a ditch or hedge. Decoys will also be found usefu these may be stuffed birds placed on branches of trees, or new killed birds in cases where the shooter is lying in wait at soı feeding place in a stubble or turnip field.

Rabbits.—Rabbits do most damage to young crops, especia to late-sown corn, turnips, and cabbages. Where farm are unable to keep down rabbits by shooting, wire netti may be resorted to, or ferrets, nets and snares may be us The snares should be of the form recommended in Leaf No. 228 (*Prevention of Cruelty to Animals*).

Where rabbits are a pest in gardens, the only effective reme is to erect a fence of wire netting right round the garden ; t netting must be let into the ground to a depth of 6 in. and be outwards.

Foxes.—Although the various Hunts will no doubt ta what measures they can to reduce the number of foxes in th respective districts, poultry keepers may still sustain much l among their stock owing to the depredations of foxes. Wh foxes are bold and determined it is difficult to suggest a really effective means of keeping them away. A little asafoet sprinkled about once a month round the entrance to ea poultry-house and round each gap in the fence or hedge wh the animals enter the field is said to be effective, while w netting, especially if roughly brushed with tar, will often as a deterrent. As a precautionary measure care should taken that the fowls are safely secured in their houses at nig

Need for Combined Effort.

The destruction of vermin is essentially a matter for lc effort, but this should not be isolated or unsystematic. most determined efforts to keep down the numbers of verı on a particular farm may be of little avail if the pests allowed to multiply on neighbouring farms. Occupiers farms or buildings should therefore join together with a v to making a systematic attempt to reduce the pests over large an area as can be conveniently dealt with. Clubs sim to those suggested in Leaflet No. 84 for the destruction sparrows might be formed, and local agricultural and ho cultural societies of all kinds should take advantage of tl favourable position for initiating concerted action among tl members, and introduce schemes for the destruction of verı

Land Settlement for Sailors and Soldiers.

ON the 15th July, 1915, the President of the Board of Agriculture and Fisheries appointed a Committee, under the chairmanship of Sir Harry Verney, to "consider and report what steps can be taken to promote the settlement and employment on the land in England and Wales of sailors and soldiers, whether disabled or otherwise, on discharge from the Navy or Army."

The Committee presented an Interim Report on 4th September, 1915, recommending that a free course of training at an agricultural college should be given as an experiment to 50 disabled sailors and soldiers, with a view to obtaining for them permanent employment on the land, and in the case of those proving specially capable, fitting them to become occupiers of small holdings.*

The recently issued Final Report (Introduction and Part 1) [Cd. 8182 ; price *6d.*] commences by assuming it to be the agreed policy of the Government to increase both the agricultural population of the country and the supply of home-grown food ; and, further, that the attainment of these objects can and ought to be promoted by attracting to the land suitable ex-Service men at the end of the war, provided always this can be done with a reasonable certainty that the men will make a good living on the land when they get there.

The Committee refer to the extent to which the defensive power of a country is strengthened by its capacity to produce food for its inhabitants, and to the danger of an undue dependence on foreign sources of food supply. There is also, so they state, general agreement that on economic grounds it is a matter of the greatest importance to increase the production of food in this country, and so reduce the amount which has to be imported from abroad. The desirability of maintaining the stability and physical strength of the nation is further adduced as a reason for encouraging as large a proportion as possible of the population to live on the land.

The demobilisation of the Navy and Army at the close of the war will, the Committee state, afford a unique opportunity of developing agriculture in this country, an opportunity which it is of the utmost importance to the welfare of the nation should be seized and turned to the greatest possible advantage. The Committee consider two classes of men : (1) Those employed in agriculture prior to the war, and of whom it is urgent that as many as possible should be induced to resume agricultural life at home, and (2) those formerly engaged in urban industry who will be reluctant to return to their former life, and who, seeking opportunities for an open-air occupation, will be attracted to the overseas Dominions, or even lost to the Empire if no such opportunities are open to them in this country.

The Committee divided their enquiry into two parts : (*a*) the settlement of men in holdings of their own, whether as proprietors or tenants, and (*b*) the employment of the men at wages, with or without a bonns or share in the profits, upon the farm or holding of another person. "Employment" is the larger problem, but "settlement" being the more immediate, the Committee devote to it the Report under notice.

It is postulated that the establishment of small holdings involves the application of more capital and more labour to the land than is

* Further particulars will be found in this *Journal* for November, 1915, pp. 813 and 814.

the case with large occupations, and that it will result in more intensive cultivation, greater productiveness and a substantial increase of the population engaged on the land. The Committee recommend, therefore, (*a*) that the State, acting through the Board of Agriculture and Fisheries, should undertake the provision of land for all suitable ex-Service men who desire fully-equipped and self-supporting small holdings, and who are prepared to settle in the places where land can be provided, under the conditions that the State considers necessary to their success. (*b*) On the other hand that the county councils, acting under the Small Holdings Act (with suggested amendments), should provide for any suitable ex-Service men who are not prepared to move to the State Colonies, or who desire accommodation holdings to be worked in conjunction with some other business.

The Committee couple with these recommendations the need for the provision for both expert agricultural advice and business organisation (especially co-operative marketing) as essential to the success of any scheme.

(a) Settlement by the State.

The Board, it is recommended, should be empowered to acquire land either by purchase (voluntarily if possible, but, failing this, compulsorily) or lease (voluntarily only). Settlement on the "colony system" is regarded as the only system possible for the State, owing to the impracticability of providing isolated holdings all over the country, and of arranging for the necessary expert guidance and business organisation; with the colony system it is possible to develop the social side of the life, and, further, larger blocks of land would be obtainable at lower prices *pro rata*.

With the *caveat* that the size of the colony must depend on various considerations, the Committee consider that the ideal settlement would be a village community of at least 100 families all interested in the cultivation and development of land, but including amongst them those engaged in the trades subsidiary to agriculture. The *minimum* acreage to be taken for a fruit and market garden settlement should, it is stated, be 1,000 acres, and for settlement on dairying or mixed holdings 2,000 acres (these figures excluding any rough or poor land which may have to be purchased as part of an estate). Larger areas will reduce the cost of management and will be an advantage from the point of view of collective marketing.

The Committee recommend that no land should be purchased or leased which is not fairly productive, kind, and easily worked; it should, as far as possible, be of similar quality throughout for each training colony (especially for fruit farming).

Types of Holding.—The fruit and market garden holding is recognised as being, on the whole, most suitable for men with little or no previous experience of agriculture; (*a*) it can be made to produce a larger return per acre than other types of cultivation, (*b*) a larger number of such holdings can be created on a given quantity of land, (*c*) an inexperienced man can be trained more easily to grow these crops, and (*d*) the planting of fruit trees, bushes, &c., could be undertaken by the State, and the cost included in the rent, so that a man could enter into occupation without having to pay a heavy ingoing, and would not have to find much capital for stocking the holding.

The home producer having a practical monopoly of milk the Committee state that they would like to see a large increase in the number

of small grass holdings; the greater risk attaching to dairying, and the need for greater aptitude and experience, and the much greater cost of stocking such a holding are alluded to. It is suggested that the Board should carefully test an arable dairying holding of 25 acres of which the staple products would be milk, pigs, poultry, cereals, and roots, lucerne being used instead of grass.

The small mixed farm of from 35 to 50 acres, comprising both arable and grass land, is not recommended for ex-Service men until they have gained a very varied knowledge and considerable experience.

Poultry farming is not recommended as a staple occupation.

Ownership or Tenancy.—This question is discussed at considerable length, and the conclusion is reached that, for the purpose in view, a system of tenancy is preferable to one of ownership. From the point of view of the State the reasons adduced in favour of tenancy are that effective supervision and control can be exercised, and that the preservation of small holdings, as such, can be assured, once they are created. From the point of view of the small holder the important advantages are greater mobility of tenancy (occupying ownership being a real impediment in the way of a man who desires to rise), and ability to employ the capital available in the stocking and working of the holding (instead of sinkiug part in purchase). Applications for the purchase of holdings, during the seven years in which the small Holdings Act has been in operation, have been very few in number.

Selection and Training of Tenants.—While applicants with experience and capital might be allowed to take holdings at once, and would serve as examples of their success, it is considered necessary that men with little or no previous experience should be given some preliminary training. The Committee's plan is that these men should be temporarily employed at a weekly rate of pay on a colony established by the State, until they acquire sufficient experience to justify making them tenants. Under this plan the Board would appoint a manager to conduct the land acquired as a large farm, and the men without experience would be offered employment at a weekly wage, together with a cottage and garden. With the acquisition of experience a portion of the farm near their cottages should be let to them, provision being made in laying out the farm so that adjoining land could be added in course of time.

Special consideration should, it is stated, be given to the capacity of the men's wives to assist in the work, and to their willingness to settle on the land. In connection with the training of such women the Committee concur in the recommendations of the Rural Education Conference (see this *Journal*, December, 1915, p. 859 *et seq.*).

Equipment and Adaptation.—The recommendation is made that the property acquired by the State should be gradually developed in accordance with a carefully prepared plan. To illustrate this a map is published showing how an area of 1,000 acres could be developed so as to provide 112 small fruit and market-garden holdings, together with additional land for extensions of the holding and a central farm.

To reduce the initial cost of equipping small areas of land with houses and buildings it is thought that the Government might hand over to the Board, free of cost, the military hutments erected all over the country, the best of which could readily be taken down, re-erected, and adapted in such a way as would convert them into comfortable and suitable rural cottages, or which could also be adapted for use as farm buildings, outhouses, etc.

The Committee state that the equipment of the colony should include, in addition to the houses and buildings required for prospective small holders, a depot and store to be used in connection with the sale of requirements and the disposal of produce, a central club room, and other buildings, such as a jam factory, creamery, etc., as may be found desirable. A private telephone system is suggested.

Any necessary works of road making, water supply, drainage, fencing, &c., should, it is stated, be carried out by the Board, and in the case of a fruit and market-garden colony, part of the land to be allotted in small holdings should be planted with fruit trees and bushes as soon as possible after the land is acquired, so that when the tenants enter into possession they will find their holdings ready stocked.

Provision of Expert Guidance.—The plan of the Committee is that there should be a resident director (at a salary of £500 a year, with house) on each colony who would be responsible for the management of the estate while farmed as a whole, for supervising the instruction of the settlers during their initial period of training, and for advising the small holders as to the cultivation of their holdings, the purchase of their requirements and the disposal of their produce. In addition, the Committee state that it would be necessary to have a practical agricultural, or, in the case of a fruit or market-garden colony, a horticultural instructor who would be responsible under the director for the actual training of the men, and whose salary, it is thought, might be £120 a year with house.

The colony could draw on the agricultural instructors of the county council for instruction in special branches, and on the staff of the provincial council for agricultural education on questions involving scientific research. The establishment of demonstration holdings run on a commercial basis is recommended; special emphasis is laid on systematic instruction in book-keeping.

Co-operation.—The Committee realise that co-operation among the small holders can only result from education, and must have time for growth. They think, therefore, that it will be better to begin by setting up, under the control of the director, an organisation which can collect their produce, dispose of it to the best advantage, and pay them the proceeds, less expenses and a reasonable commission. The Committee hope that, as the small holders acquired experience, realised the advantages of collective dealing, and became educated in the principles of co-operation, they would become capable of taking over the control of the organisation, and running it as a co-operative society.

It is recommended, therefore, that in each fruit and market-garden colony a depot should be established for the produce of the colony, which should be collected, graded, packed, and despatched to market. The depot should be under the control of the director, who would be in touch with all the markets. Similar arrangements are recommended in other types of colonies. In connection with the depot it is thought that provision should be made for dealing with any surplus produce, which could not be sold, by the establishment of a jam factory, pulping and drying plant, a creamery, a cheese factory, etc.

Besides this sale depot a store is recommended for the purchase or hire by the small holders of tools, feeding stuffs, etc., and facilities should, it is stated, be provided whereby the small holders could obtain the use of the larger farm implements and machinery, and the hire

of horses and extra labour. For this purpose the retention of part of the colony as a well-equipped central farm is recommended.

Provision of Working Capital.—The Committee reject the proposal that the State should make direct advances of working capital to ex-Service men who desire to take up small holdings. Instead, they make the following recommendations :—

(1) They think that the burden of tenant-right, which is often a severe tax on the resources of small holders, can be eased on the State colonies. An incoming tenant should not be required to take over hay or straw in excess of his actual needs ; the cost of planting in the case of a fruit holding could properly be treated as a permanent improvement and spread over a period of years, and the Board, on the recommendation of the director of the colony, might be given a discretionary power to defer payment in full in cases where they are satisfied that such a course is justifiable.

(2) With regard to the cost of maintenance of the small holder and his family until a return is got from the holding the Committee suggest that arrangements should be made for tenants to enter at such a time that they will be able to obtain a return without a long interval.

(3) The lack of capital for purchasing the stock, implements, etc., for the holding is met by the Committee's scheme of starting the ex-Service men as labourers at a weekly wage, and gradually adding to the men's land as they became skilled. In this way the principal need will be for small advances for industrious men towards the purchase of a pig, a calf, or, later on, a cow or two, and the Committee think this need should be met by the establishment of a co-operative credit bank in connection with each colony.

As an experiment it is recommended that the State should set aside a small sum of money to be lent to credit banks so set up—5*s.* an acre is suggested as the amount. The residents should be invited to take up shares and deposit their savings with the society. Limited liability is suggested, with State guarantee of members' deposits.

Social Amenities.—In addition to recommendations as to social amenities, educational facilities, and places of worship, the need for opportunities of subsidiary employment is alluded to.

Rents.—In order to place their scheme on a sound economic basis the Committee would have sufficient rents charged to meet the interest on the cost of the land and the equipment, the statutory outgoings, and a reasonable allowance for repairs, insurance, management, etc. The cost of the educational staff of the colony would not be charged on the rent.

The Committee estimate that the rent of a small fruit and market-garden holding of 4 acres, provided with a cottage, pigsty, fowlhouse and tool shed, and with 1½ acres planted with fruit trees and bushes, would be about £24 a year, and that additional land without equipment could be let at a rent of from £2 to £2 10*s.* an acre, so that the rent of a 10-acre holding would be from £36 to £40 a year. The rent of a dairy or mixed holding of 25 acres provided with a cottage and the necessary buildings would be about £74 a year, if the land was purchased at £40 an acre ; and additional land without equipment could be let at a rent of about £2 2*s.* an acre.

After outlining their scheme the Committee refer to the need for prompt action ; and they recommend that immediate steps should be taken by the Board to acquire and equip land for three pioneer

colonies (illustrating the different types of holding), comprising 5,000 acres in all, and that additional land should be acquired for the settlement of further colonies.

From estimates given by the Committee it appears that the cost of establishing the three pioneer colonies would not be more than £334,000, viz., £215,000 for the cost of the land, and £119,000 for the cost of equipment, tenant-right, and farm capital (it is assumed that military hutments will not be available). The three pioneer colonies are not likely to accommodate more than 300 families. To provide for at least 4,000 or 5,000 families a sum of £2,000,000 should, it is recommended, be placed at the disposal of the Board.

(b) Settlement by County Councils.

The Committee anticipate that county councils will experience a largely increased demand for small holdings when the war is over, quite apart from the applicants who will be provided for in the State colonies; and it is to be expected that many applicants who are ex-Service men will wish to settle in the neighbourhood whence they came, and will probably not be prepared to go to the State colonies.

It is recommended, therefore, that county councils should undertake the provision of small holdings for such men, and that as far as possible they should establish colonies similar to the State colonies outlined above. To this end the Public Works Loan Commissioners should, it is stated, be authorised to resume the issue of loans to councils for the purchase and adaptation of lands for small holdings.

It is further recommended that the Small Holdings Act should be amended so that the Board may become partners with the county councils in the whole business of providing small holdings under the Act, and may pay half of any losses that may be incurred.

The Committee think that it would be an additional inducement to county councils to establish colonies rather than isolated holdings if the Board were authorised to contribute towards the salary of a resident instructor, and towards the initial capital cost of providing a central depot, store, jam factory, creamery, or other similar organisation, for any colony created by a county council. If the military hutments are handed over to the Board, some of these, it is thought, might be placed at the disposal of county councils for colony purposes.

Other amendments suggested to the Small Holdings Act are that:—

(1) Councils should be given the same powers to improve and manage their property as are possessed by trustees of a settled estate.

(2) The maximum term of 50 years for loans for buildings on small holdings should be extended to 60 years.

(3) Buildings erected under the Act with the approval of the Board should be exempted from local by-laws.

(4) Provision should be made to deal with the grievance of the tenants of small holdings that they have to pay in their rents for the purchase of the land.

(5) Section 41(3) should be repealed.

(6) The powers of county councils to acquire land for the purpose of providing small holdings should be extended to the purchase or hiring of land for the purpose of leasing it to a parish council for sub-letting it in allotments.

The Case of Disabled Men.

The Committee are strongly opposed to the segregation of disabled men, or to anything like the establishment of colonies for cripples.

Committees established under the Naval and Military War Pensions Act, 1915, are responsible for training and finding employment for disabled men, but in the present Committee's view it is undesirable that the State or county councils should deal with the settlement on the land of able-bodied men, and that another authority should deal with disabled men; and the Committee think, therefore, that any disabled men who desire to settle in State colonies should be sent on to the Board, while the men who desire local small holdings should be referred to their proper county councils.

Adequate funds should, it is recommended, be provided by the State for the training of disabled men who desire to settle on the land; and such training should be given by the Board on behalf of the Statutory Committee under the Naval and Military War Pensions Act.

It is recommended that, after being trained, disabled men should be treated on the same footing as able-bodied men, except that in selecting tenants of small holdings they might be given the preference if other things are equal.

Finally, it is recommended that a propagandist campaign in favour of land settlement at home should be undertaken by the Board with the assistance and co-operation of the Admiralty and War Office prior to the demobilisation of the Navy and Army.

Report of the Development Commissioners, 1914-15.

IN their Report for 1914-15 [H. C. 408, 1916] the Development Commissioners explain that the effect of the war on the sphere of their operations has, so far, belied immediate expectations; the anticipations of unemployment on an extensive scale were falsified and the initial policy of the Commissioners of encouraging the submission of schemes of land lrainage, afforestation, &c., was replaced by the discouragement of vorks employing labour suitable for enlistment. An exception was, ɪowever, made by the Commissioners in the case of fisheries as being ɪf great value towards helping the home food supply.

The curtailment of the expenditure from the Development Fund ·pon fresh schemes did not diminish the activities of the Commission o much as might at first appear, since, firstly, a number of schemes .ad been established with a reasonable expectation of continued help rom the Development Fund, and secondly, there is likely to be a widepread demand after the war for labour-employing works. Under he first head the Commissioners usually recommended just sufficient dvance to secure continuity; and in the second case they devoted hemselves to the initial stages and projects of development which ·ould, in their execution, have the effect of employing labour on a ɪrger scale and to exploring preliminary engineering, administrative nd legal questions which delay the actual start of work. For the urpose of removing difficulties in the way of land drainage schemes, ɪe Land Drainage Act, 1914, was passed.

The general effect of the war upon agriculture, and the probable osition of agriculture after the war engaged the Commissioners' ttention; the chief question for immediate consideration was the ɪcrease of the home food supply, and considerable advances were ·commended in aid of schemes for the increase of the production and reservation of food commodities. The provision at the end of the war

of opportunities of agricultural work on a large scale, and upon conditions calculated to satisfy men who have been serving in the army, was also kept in view.

The following more detailed account of the action of the Commissioners relates to England and Wales only.

Agricultural Research and Education.—After the outbreak of war it was decided by the Commissioners, with the consent of the Treasury, that the work of the newly founded Research Institutes should, so far as possible, be maintained, having in view their importance for the future development of agriculture. Some continuity has in this way been preserved at eacb of the institutes. Since, however, a large proportion of the men engaged have volunteered for active military service, and have been replaced in some cases by voluntary workers, considerable reductions have been made on the expenditure involved. For the continuance of the scheme in England and Wales during 1915-16 the Commissioners recommended the following grants to the Board of Agriculture and Fisheries :—

Grants to Colleges and Institutions in aid of—	£
(*a*) Scientific Research and Experiment	27,247
(*b*) The extension of Advisory and Local Investigation Work	9,550
(*c*) Special Investigations and Research	2,900
Research Scholarships in Agricultural and Veterinary Science	4,650
Expenses of Administration	1,100
	£45,447

Apart from the maintenance expenses of research and other work carried on at universities, research institutes, and agricultural colleges, additions are, in many cases, necessary to buildings and equipment before that work can be properly done, and some capital advances had already been made to assist agricultural institutions to obtain better accommodation and more adequate equipment. During 1914-15 the Commissioners recommended the following grants for similar purposes on the basis that only 50 per cent. of the total expenditure necessary is met from the Development Fund, the other 50 per cent. being provided by the institution or otherwise locally :—

Bristol University.—Supplementary grant of £1,250 in aid of the buildings required for a Research Institution in fruit growing.

Leeds University.—Grant of £12,000 in aid of the cost of the erection and equipment of a new building for the University Department of Agriculture.

Rothamsted Experimental Station.—(*a*) Grant of £6,000 in aid of the erection of a new laboratory.

(*b*) Supplementary grant of £986 10*s.* in aid of the erection of new farm buildings and the extension of the laboratories.

Seale-Hayne Agricultural College.—Supplementary grant of £1,825 in aid of the provision of college buildings.

South-Eastern Agricultural College, Wye.—Supplementary grant of £500 in aid of the erection and equipment of new college buildings.

The necessary complement of this scheme for encouraging research, and providing technical advice through universities and colleges is an extension of a simpler and more immediately practical type of agricultural education, and a considerable addition to the existing provision of help and advice of a less purely scientific kind. For this purpose the Commissioners had already recommended grants for the establishment and extension of farm institutes. The Board of Agriculture applied for a grant of £63,500 to meet expenditure for this purpose during 1915-16, and stated that considerable developments had taken

place notwithstanding that in some counties schemes which were under consideration in the spring of 1914 for the purchase of land for farm institutes, or the appointment of additional staff, have been postponed until the end of the war. A grant of £43,500 was made, and the Commissioners asked the Board to use every effort to induce Local Education Authorities not to proceed with their building schemes during the war. A grant of £1,500 was also made to the Board in aid of the expenses during 1915-16 of the advisory councils established in connection with the Board's scheme for the development of agricultural education and the improvement of live stock.

Shortly after the outbreak of war the Commissioners received a request, made on behalf of the Central Committee on Women's Employment, for assistance in starting the rural industries of vegetable drying and fruit canning (with pulp and jam-making subsidiary to it). A large and immediate demand, owing to the war, existed for the products, and it was believed that these industries offered a new and hopeful opening for demonstration and experiment, as well as for the employment of women and girls. The Commissioners recommended a grant to the Board of such sum as may be required not exceeding £3,000 for the necessary plant and working capital. Experiments are being undertaken in two factories in Warwickshire under the supervision of a Committee appointed by the Board in order to test the prospects of these industries on a commercial scale. It is hoped that when these industries have passed the experimental stage, they may be taken up in the locality and elsewhere on a co-operative basis.

Later in the year the Commissioners recommended a further grant to the Board of £3,000 for 1915-16 to enable them, in consultation with the Commissioners, to assist emergency schemes of an educational or quasi-educational character. Advances from this grant have already been approved for the instruction of women in milking and other light farm work, the establishment of a number of migratory cheese schools, and a scheme for augmenting the production of eggs and poultry.

Poultry Improvement.—The following grants were made:—

(1) £708 to the Utility Poultry Club for the extension of Major Hurst's Burbage experiments in 1914–15.

(2) £125 to the club towards the working expenses of a 10 months' laying competition beginning in October, 1914.

(3) £120 to the Board of Agriculture and Fisheries for the purpose of an experimental scheme during a period of one year, in two counties in England and one in Wales, for the supply of eggs for hatching to cottagers and small holders.

Cultivation and Preparation of Flax and Tobacco.—The Commissioners recommended a grant to the British Flax and Hemp Growers' Society of £2,600 for the continuance of its work in the year 1914-15. A grant of £3,000 was also made to the University of Leeds for the continuation during the year October, 1914, to September, 1915, of the investigation into the cultivation and treatment of flax conducted at Selby by the University.

The Commissioners recommended a grant of £5,000 to the British Tobacco Growers' Society in aid of its work during the year 1914-15, as they were satisfied that the work of the Society promises useful results in the way of definite information as to the commercial conditions and possibilities of the crop.

Horse and Live Stock Breeding.—The following grants for these schemes during the year 1915-6 were recommended to the Board of Agriculture and Fisheries :—

(a) £26,500 in aid of light horse breeding in England and Wales.
(b) £40,400 in aid of the scheme for the improvement of heavy horses, cattle, and swine, the extension of milk recording, and the employment of live stock officers at Agricultural Institutions in England and Wales.

Co-operation among Agriculturists.—A Joint Committee of the Development Commissioners and the Board of Agriculture and Fisheries was appointed to consider and report upon an application by the Agricultural Organisation Society for the continuance of grants, but in order that the Society might be able to carry on its work pending the completion of the enquiry, the Commissioners recommended a grant, not exceeding £4,000, in aid of its work during the half-year ended 30th September, 1914. In November, 1914, a report was made by the Committee, whose conclusions were accepted by the Commissioners, and a further grant, not exceeding £5,000, was recommended for the year 1914-15. The total grant for the year was made upon the same basis as the grant for 1913-14, viz.: a grant of £6,000, and a further grant equal to the subscription income of the Society for the year, but not in any case exceeding £3,000. Certain recommendations in detail as to the conduct of the business of the Society were made by the Joint Committee, and have been accepted by the Governors of the Society. The Society has been informed that it must not expect a continuance of the grant upon the same basis indefinitely, and that it should make every endeavour to render the movement far more self supporting.

Forestry.—Assistance from the Development Fund has been given for the past 3 years in support of a scheme which provides instruction and advice at 5 centres in England and Wales (Oxford, Cambridge Cirencester, Bangor and Newcastle), and provides also for research work and minor forestry experiments. The application of the Board of Agriculture and Fisheries for a grant of £7,200 to continue this scheme during 1915-16 was under consideration at the close of the year.

The following advances were recommended :—

(a) £800 to the Commissioners of Woods, &c., as a further capital grant in aid of the scheme for utilising Dean Forest and the adjoining woodlands as a demonstration area ;
(b) £100 to the Commissioners of Woods, &c., to meet the salary and expenses of an officer employed temporarily for special emergency work at Dean Forest consequent upon the war ;
(c) £150 to the Board of Agriculture and Fisheries for the provision of three scholarships to enable students at woodmen's schools to proceed for one year to a centre for higher training in forestry ;
(d) £500 to the English Forestry Association to assist work in obtaining information and organising supplies of timber for collieries and other industries.

Reclamation and Drainage of Land.—In view of the desirability of getting labour-employing schemes ready to put in operation at the end of the war, the Commissioners devoted considerable attention to the preliminary stages of schemes of land drainage in East Anglia particularly in connection with rivers flowing into the Wash. The Land Reclamation Society has been constituted, and a grant of £350 was made to it for preliminary expenses in connection with an area in Merionethshire. A further advance of £1,000 was made towards the reclamation scheme at Methwold carried on by arrangement with the Duchy of Lancaster.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

Influence on Crop and Soil of Manures Applied to Permanent Meadow (*Jour. Agric. Science*, September, 1915; *C. Crowther and A. G. Ruston*).—A comparative test of different systems of manuring meadow land has been carried on continuously and uniformly since 1899 at the Manor Farm, Garforth; precisely similar tests were made for several years at five other centres in the West Riding of Yorkshire. The soil is a light loam very poor in lime in a district of medium rainfall (20–25 in.).

The chief conclusions drawn from the results are as follows:—

1. Although the heaviest crops have been obtained with an annual application of dung, they are little heavier, and more costly to obtain, than the crops obtained with a biennial application of dung especially if in the alternate year a light dressing of "artificials," including nitrate of soda, be given.

2. A complete mixture of "artificials," including nitrate of soda, has given good average crops, but not equal to those given by a biennial application of dung.

3. For the soil and other conditions of Garforth, nitrate of soda is distinctly better for the hay crop than sulphate of ammonia. This is doubtless largely associated with the poverty of the soil in calcium carbonate.

4. The different manurings have effected marked and characteristic changes in the botanical composition of the herbage. In particular, the continued use of ammonium salts has led to serious deterioration.

5. There are now differences also in the chemical composition of the herbage, which probably represent substantial differences in feeding value. For equal weights, the hay grown with dung appears to have a lower feeding value than that grown with a good mixture of "artificials."

6. The composition of the ash of the hay does not reflect the character of the manuring, except with regard to potash.

7. Substantial changes in the power of the soil to supply plant food have taken place as a result of the manuring. The most marked effect is the removal of carbonate of lime by the prolonged use of ammonium salts.

8. The effects—direct and indirect—of the manuring upon the soil have led to marked differences in bacterial activity. In some cases the reduction in biological activity is so great that dead grasses accumulate and form a mat on the soil so thick that the penetration of water to the lower layers is seriously impeded.

Improvement of Upland Grazings (*Paper read at Brit. Assoc.*, 1915; *D. Macpherson, B.Sc., and W. G. Smith, B.Sc., Ph.D.*).—The upland grazings in Scotland comprise 48 per cent. of the total land area of the country; they are mainly devoted to sheep-farming with the Blackface and Cheviot Mountain breeds; cattle grazing is confined to the lower marginal areas.

The dominant plants in the *peatlands* are heather, cotton grass and deer-hair grass, which provide valuable spring grazing. Retrogression

* A summary of reports on agricultural experiments and investigation is usually given in the *Journal*. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.

of peat is widespread and little improvement is possible, draining increasing the proportion of heather but reducing that of cotton-grass and deer-hair grass, and favouring invasion of *Nardus*.

Nardus grassland occurs on wasting peat on steep slopes marginal to the moorland. It invades and is successive to the vegetation of the peatland; it is of secondary grazing value. Where flushing is possible good pasture may be induced; otherwise the grazing value is improved by burning on a short rotation.

Heatherlands form valuable grazing ground at all seasons. They are found on slopes where continuous leaching has impoverished the upper layers of the lighter soils, and where slow accumulation of humus occurs. The grazing value is greatly increased by regular burning on a suitable rotation; different burning rotations will be required according as the reinvenating powers of the heatherland are slow or rapid.

Alluvial and Flush Grasslands provide the best pasturage on stream-side alluvials and on hill slopes flushed with water from springs; they may be used as wintering grounds or enclosed as meadows. The alluvia of the upper valleys are light and, accordingly, retrogression occurs through leaching where flushing is prevented. The lower valley alluvia tend to be heavier and their maintenance as grazing units depends on drainage. These grasslands can be made to replace heather and *Nardus* by suitable irrigation with water derived from springs or with surface water bearing rainwash. Invasion of acid water deteriorates the pastures, favours *Nardus*, and, where "pan" is formed, promotes retrogression to moorland. These grasslands are suitable subjects for manurial treatment (*e.g.*, basic slag). Destruction of bracken increases the productive capacity of the pasture.

LIVE STOCK, FEEDING STUFFS AND DAIRYING.

Cost of Food in the Production of Milk on Three Yorkshire Farms (*Paper read at the Brit. Assoc.*, 1915; *Prof. C. Crowther, M.A., Ph.D., and A. G. Ruston, B.A., B.Sc.*).—During the last four years investigations as to the cost of food in the production of milk have been carried out on a number of farms in the North and West Ridings of Yorkshire. In making the estimates the purchased feeding-stuffs have been taken at cost price, but for the home-grown feeding-stuffs the following arbitrary scale has been used (per ton): hay 55*s*., oat straw 30*s*., barley straw 25*s*., mangolds 10*s*. 6*d*., swedes 10*s*., turnips 8*s*., and 3*s*. 6*d*. per week for grazing for spring calves.

During the past year detailed records have been kept on three of the farms, which enable the *actual* costs of production of the home-grown feeding-stuffs on these farms to be arrived at. These were as follows:—

Costs of Production of Home-grown Foods.

Herd.	Grass.	Hay.	Straw.	Roots.
	Cost per Cow per Week.	Cost per Ton.	Cost per Ton.	Cost per Ton.
	s. *d*.	£ *s*. *d*.	*s*. *d*.	*s*. *d*.
A	2 0	1 13 0	10 6	5 8
B	1 7	1 8 9	15 2	7 7
C	1 9	1 11 0	14 6	8 5

The following table shows the results obtained by the two cost of production methods :—

Estimated Average Cost of Food per Gallon of Milk.

Herd.	Average Milk Yield per Head per Year.	"Arbitrary Scale."		"Cost Scale."	
		Total Cost of Food per Head per Year.	Average Cost of Food per Gallon of Milk.	Total Cost of Food per Head per Year.	Average Cost of Food per Gallon of Milk.
	Gallons.	£ s. d.	Pence.	£ s. d.	Pence.
A	677	14 0 6	4·97	9 11 6	3·39
B	656	13 17 5	5·08	9 13 9	3·54
C	672	14 13 6	5·24	10 10 4	3·76

Phosphorus Requirement of Lambs (*Jour. Agric. Research* [U.S.A.], August, 1915).—The results of these experiments indicated that the phosphorus requirement for the normal growth and fattening of lambs does not exceed 3 grammes per day per 100 lb. live-weight.

Hereditary Twinship in Sheep (*Jour. Agric. Research* [U.S.A.], September, 1915).—Data obtained from the American Shropshire Sheep Record are examined by statistical methods, and the conclusion is reached that, for the class of sheep considered, twin parents in general give a larger percentage of twins among offspring than do parents born as singles.

FORESTRY.

Effect of Grasses and Weeds round the Roots of Young Forest Trees (*Quart. Jour. Forestry*, July, 1915; *S. F. Armstrong and E. R. Pratt*).—Fourteen plots were laid cut in 1912 on a rather sandy and porons soil on the Lower Greensand. On each plot were planted three young trees of ash and two of larch, the distance between each tree being 16 in. to 17 in. Round the young trees were planted or sown various grasses and weeds, two control plots being kept free from these.

At the close of the first season the most striking features were the unhealthy appearance of the buds and foliage of the trees on the grass-covered plots. In the second season the harmful effects were again observed in greater degree, and the difference between the trees on the control plots and the other plots as regards height and general vigour was very marked in all cases.

The following table shows the total increase per plot in height in the two seasons. It will be seen that the toxic effect of grass is greater than that of the two common weeds tried :—

	In.	Per cent.
Perennial Rye grass	21	13
Couch grass	24	15
Control	164	100
Smooth-stalked Meadow grass	49½	31
Wood False Brome grass	46	29
Stinging Nettle	65½	41
Yorkshire Fog	43½	27
Creeping Buttercup	83	52
Cocksfoot grass	36	23
False Oat grass	47½	30
Fiorin sown	29	18
Control	150½	100
Fiorin planted	51½	33
Giant Brome grass	48½	31

The shading power of the plants had little or nothing to do with the harmful effects observed ; and it was clear that the grasses forming the densest covering with their rapid-growing fibrous roots produced the most serious toxic effects.

The relative effect of the different species upon the two kinds of trees was very similar, though on the whole the larch suffered more in the first year, and the ash more in the second.

Rest Period in Plants (*Missouri Univ. Agric. Expt. Sta., Research Bull.* 16).—Investigations carried out in 1905–6 with twigs of broad-leaved trees and shrubs established the fact that nearly all woody plants native to the temperate zone have a "rest period," *i.e.*, at the beginning of winter, if placed under favourable conditions for growth, the plants remain dormant. Doubts having been cast on the use of twigs in the investigations alluded to, further tests were commenced in 1907 with a collection of one to three year old seedlings in pots in order to obtain further details as to their dormant periods. The bulletin gives particulars of the normal dormant periods in the case of each of 42 species tested, together with the treatment applied to initiate growth, and the results obtained.

The tests with pot-plants confirmed those carried out with twigs, *viz.*, that all woody plants rest annually for a longer or a shorter period. It was found that the rest period could be broken and growth initiated by special treatment. In the autumn the plants were removed to the greenhouse without being exposed to frost. They were then either dried, frozen, or etherized for various periods, from 24 hours to 8 days, and in the majority of cases growth was initiated in the course of a few weeks after treatment. Ether was found to be by far the most efficient agent for the purpose, though in the case of the pot-plants the soil had to be dried or else carefully covered up to prevent the absorption of the ether by the soil. A few species, among which are *Fraxinus Ornus* and *Juglans nigra*, are very difficult to arouse into growth, but it is believed that the rest period can in all cases be broken by proper treatment.

It would appear that the explanation of the rest period is to be sought in the buds rather than in the roots or in the cambium of the trunk or branches. It is considered probable that plants become dormant because the enzymes or ferments cease to work, and that growth starts again when these ferments are activated.

An investigation is now being conducted for the purpose of studying the work and activities of the enzymes during the dormancy of woody plants as well as during growth.

OFFICIAL NOTICES AND CIRCULARS.

Foot-and-Mouth Disease in Somerset.

THE existence of foot-and-mouth disease amongst animals on the premises of the County Asylum, Wells, Somerset, has been confirmed to-day.

The usual precautions have been taken to prevent the spread of the disease, and an Order has been made prohibiting the movement of animals in a large area surrounding the infected farm.

Women's Work on the Land.

THE Board of Trade, in consultation with the Board of Agriculture, are taking active steps to mobilise a sufficient supply of women for work on the land in order to meet the shortage of agricultural labour due to the enlistment of men in His Majesty's forces. The reserves of women's labour available for agriculture are to be found chiefly among the local unoccupied women in country villages who have some experience of or familiarity with agricultural work, and also among the better educated women who are willing to be trained for this purpose.

A scheme has already been adopted in many counties which is producing satisfactory results. Women's county committees, working either in co-operation with, or as sub-committees of the War Agricultural Committees, have already been established in twenty-five counties; in the other counties it is hoped that similar committees of women will shortly be formed. A scheme of systematic propaganda work is being carried on in all parts of the country by means of local meetings, followed by house to house canvass. Village registers are being established, and women urged on patriotic grounds to enrol for farm work for whole or part time. In order to press forward with this work, the Board of Agriculture is forming a panel of speakers who will be available to address meetings, and additional women organisers have been appointed by the Board of Trade and allocated to various parts of the country.

Purchase of Sulphate of Ammonia by Farmers.

IN view of the uncertainty as to the sufficiency of the supplies of sulphate of ammonia to meet the home demands during the next few months it has been decided, on the recommendation of the Fertilisers Committee, with the approval of the President of the Board of Agriculture and Fisheries and the President of the Board of Trade, to suspend for the present the issue of licences for the export of sulphate of ammonia. Under normal conditions it is well known that the production of sulphate of ammonia considerably exceeds home requirements, but Lord Selborne confidently hopes that farmers will this year greatly increase their demands for fertilisers of all descriptions so as to stimulate, so far as practicable, the production from the land, and thus reduce the importation of foodstuffs. This stimulus is the more necessary to counterbalance, in some degree, the hindrances to production arising from shortage of labour and other causes. Lord Selborne, therefore, appeals to farmers generally to justify his belief in their enterprise and patriotism by availing themselves of the opportunity now provided to secure plentiful supplies of fertilisers.

Farmers are especially urged to place their orders for sulphate of ammonia at once so as to enable the expected increased demand to be met without undue delay or difficulty.

Sulphate of Ammonia: Need for Increased Purchase by Farmers.

LORD SELBORNE desires to call the attention of farmers to the fact that the decision to suspend the issue of licences for the export of sulphate of ammonia was based on the assumption that the home demand for this fertiliser would be substantially increased. Unless, therefore, farmers at once increase their demand, the result will be that stocks

tailed. In view of the importance of using every effort to stimulate the production of maximum crops during the war, in the interests both of agriculture and of the nation generally, Lord Selborne appeals to farmers to avail themselves, without delay, of the present opportunity to procure supplies of sulphate of ammonia for spring use.

Leaflets dealing with the use of sulphate of ammonia may be obtained, free of charge, on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

Notice to Farmers: Military Service Act, 1916.

1. **To whom the Law applies.**—The Act applies to all British subjects who:—

(1) Were ordinarily resident in Great Britain on the 15th August, 1915, or have become or hereafter become ordinarily resident in Great Britain since that date.

(2) Had attained the age of 18 years on the 15th August, 1915, and had not attained the age of 41 before the "appointed date" (2nd March, 1916).

(3) Were, on the 2nd November, 1915, single or were widowers without children dependent on them, subject to certain exceptions amongst which are:—

- (*a*) Members of His Majesty's Regular or Reserve Forces.
- (*b*) Men who have left or been discharged from the naval or military service of the Crown in consequence of disablement or ill health.
- (*c*) Men who have offered themselves for enlistment and have been rejected since the 14th day of August, 1915.

It does not apply to Attested Men.—The Act does not apply to men who voluntarily attested under the Group System (commonly known as Lord Derby's Scheme) in Section B, Army Reserve, and who are entitled to wear an armlet as being soldiers in the Reserve.

2. **Persons deemed to have been Enlisted.**—Every man to whom the Act applies, and who is not included in the list of exceptions, will on the appointed date (2nd March, 1916) be deemed to have been enlisted, and to have been passed to the Reserve.

It is the intention of the Army Council that the men shall be placed, and be called up in age classes as in the case of men voluntarily attested.

3. **Who may be Exempted: Certified Occupations.**—Under Section 2 (2) of the Act, Government Departments are empowered to certify that men engaged in certain occupations (known as "certified occupations") may be exempted on the ground that the work of such men is work of national importance; and the *Agricultural Occupations* which have been so certified by the Board of Agriculture and Fisheries are as follows:—

Agricultural Engine-men and Mechanics.—Agricultural Machinery, Steam Ploughs, and Threshing Machines Attendant, Driver, Mechanic.

Farm Workers.—Farm Bailiff, Foreman, Grieve, Steward.
,, Beastman, Byreman, Cattleman, Stockman, Yardman.
,, Carter, Horseman, Ploughman, Teamster, Waggoner.
,, Hind (if foreman or ploughman).
,, Servant (if foreman or ploughman) (Scotland).
,, Shepherd.

Thatcher.

Farmers and Market Gardeners.—Farmer (including market gardener and fruit farmer) provided that :—

(*a*) Farming is his sole occupation, and his personal labour or superintendence is indispensable for the proper cultivation of his holding ; or,

(*b*) If he is partly occupied in another occupation, and his personal labour or superintendence is indispensable for the proper cultivation of his holding, and such cultivation is expedient in the national interest.

Hop, Fruit and Market Gardens. Foreman in all departments.

Stud Attendants.—Stallion man (a man who looks after and travels a stallion). Stud Groom (Scotland).

It will be seen that these "certified occupations" are the same as those hitherto known as "starred" or "reserved" occupations, with some additions and revisions, notably that of "*Farmer* (including *Market Gardener and Fruit Farmer*)."

"*Occupation*" *Claimed must be Genuine.*—The only persons entitled to be exempted on account of being employed in the "certified occupations" are those whose principal and usual occupation is one of those included in the above list. By the use of the term "principal and usual occupation" it is intended to exclude from exemption those persons who may be only occasionally employed in work of a kind similar to that of one of the occupations, but who do not follow it in any regular fashion, and are not really engaged in the occupation in the proper sense of the word.

4. **Men in Certified Occupations must apply for Certificates of Exemption.**—Application must be made for a certificate of exemption in the case of every man in one of the "certified occupations" *who has not attested, and who desires to be exempted from the provisions of the Act.* The fact that he may have already been "starred" or included in the list of "reserved occupations" makes no difference in this respect.

5. **Application to be made to the Local Tribunal.**—Applications for exemption must be made to the Local Tribunal for the area in which the place of the applicant's employment is situated.

6. **Apply before 2nd March, 1916.**—Applications for exemption must be made before the appointed date, which is the 2nd March, 1916, and may be made either by the man himself who desires exemption, or by some person, his employer, for example, in respect of him. It will be an advantage that in the case of an employed person, a signed statement should be furnished from the employer giving full particulars of the man's occupation.

7. **Forms of Application must be obtained.** — Applications for exemption must be made *in duplicate* on the prescribed form which may be obtained from the Clerk of the Local Tribunal.

8. **How to obtain and send in Forms.**—Applications for forms and forms of application when filled up must be addressed to the Office of the Clerk of the Local Tribunal, and may be delivered at or sent by post to that Office.

9. **Exemptions Granted to Men in Certified Occupations unless Objected to.**—A certificate of personal exemption must be granted by the Local Tribunal to any man who shows that his principal and usual occupation is one of those in the list of "certified occupations" (see para. 3 above) *unless an objection has been received from the military representative.*

10. **Grounds on which Exemptions may be Objected to.**—The military

representative may object to a certificate of exemption being granted on the grounds that :—

(a) The man's principal and usual occupation is not in fact one of the "certified occupations," or that

(b) Notwithstanding that the man's principal and usual occupation is one of the "certified occupations" it is no longer necessary in the national interest that he should continue in civil employment.

11. **Exemption may be "Absolute" or "Conditional" or "Temporary."**—A certificate of exemption in respect of a man in a "certified occupation" will generally be absolute. A certificate will be conditional or temporary only if there are special reasons for this course. All certificates will be open to review on the application of the holder of the certificate or of the military authorities.

12. **Claims for Exemption in Occupations other than Certified Occupations.**—An application for a certificate of exemption may also be made by or in respect of a man who is not engaged in a "certified occupation," on any of the following grounds :—

(a) On the ground that it is expedient in the national interest that the man should, instead of being employed in military service, be engaged in other work in which he is habitually engaged

(b) On the ground that it is expedient in the national interest that the man should, instead of being employed in military service, be engaged in other work in which he wishes to be engaged.

(c) If the man is being educated or trained for any work, on the ground that it is expedient in the national interests, that instead of being employed in military service, he should continue to be so educated or trained.

(d) On the ground that serious hardship would ensue if the man were called up for Army service owing to his exceptional financial or business obligations or domestic position.

(e) On the ground of ill health or infirmity.

(f) On the ground of a conscientious objection to the undertaking of combatant service.

and the Local Tribunal, if they consider the grounds of the application established, and the military representative assents to the application, shall issue such a certificate to the man in respect of whom the application is made. A certificate of exemption may be absolute, conditional, or temporary, as the Local Tribunal think best suited to the case.

13. **Appeals from decisions of Local Tribunals must be made within 3 days.**—Appeal Tribunals will be established to which an appeal may be made by any person dissatisfied with the decision of the Local Tribunal or by the military authorities. The appeal must be made not later than three clear days after the decision of the Local Tribunal, and proper forms for the purpose may be obtained from the Clerk to the Local Tribunal. Further appeal may be made by leave of the Appeal Tribunal from that Tribunal to the Central Tribunal, but it is not intended that cases shall come before the Central Tribunal unless important questions of principle are involved, or unless there is some other special reason why an appeal should be allowed.

14. **Applicants for Exemption not to be called up pending decision on Application.**—A man who has made an application for exemption within the time fixed (*i.e.*, before 2nd March, 1916) will not be called up until his application has been finally disposed of, and, if granted a

certificate will be exempted according to the terms of that certificate from the provisions of the Act.

15. **Duration and Renewal of Exemption.**—A man who holds a certificate of exemption will not be deemed to have been enlisted while his certificate is in force, and if it ceases to be in force he is allowed a period of two months in which, if he is entitled to be exempted, he can obtain a renewal of the certificate.

16. **Cases of Men who have applied to be treated as "Starred."**—In a number of cases, application has already been made under the old arrangement, to the existing Local Tribunals, that a man is entitled to be treated as a "starred" man because he is engaged in a "starred" occupation, but has not in fact been "starred."

It has been provided as regards these cases that if a decision has been given by the Central Appeal Tribunal, that the man is to be entitled to be treated as "starred," the letter conveying the decision of the Central Appeal Tribunal is to be accepted as conclusive by the Local Tribunal, that the principal and usual occupation of the man is one of those in the list of "certified occupations," and that, so far as his occupation goes, he is, therefore, entitled to a certificate of exemption. The case will be open to review in the same manner as the cases of other men holding certificates of exemption.

17. **Men who have attested under "Lord Derby's Scheme."**—The cases of men who have attested voluntarily under the "Derby Scheme" do not come within the provisions of the Act, but it is the intention that the two classes of cases, those of men who came under the Act, and those of men who have voluntarily attested, shall be dealt with on the same lines and the constitution of the existing Local Tribunals will be modified where necessary for this purpose.

New instructions will be issued by the Local Government Board for the observance of Local Tribunals in dealing with these cases, and such instructions will supersede those previously made.

Under the existing instructions, the Local Tribunals can grant only postponement—under the new instructions, they will be able to grant exemption.

18. **No further applications to be treated as "Starred."**—Applications will not be entertained in future by Local Tribunals that a man is entitled to be treated as "starred." It is proposed to provide that a voluntarily attested man whose principal and usual occupation is one of those included in the list of "certified occupations" may go to the *local military representative* and claim that he is engaged in one of these occupations, and, therefore, should not be called up for military service. If the military representative agrees to the claim the necessary steps will be taken by the military authorities to secure that the man is not called up so long as the exemption continues, and the matter will not come before the Local Tribunal. If the military representative disagrees application may be made by or in respect of the man to the Local Tribunal, who will decide the case in accordance with the Instructions.

Notice to Farmers as to Soldier Labour.

THE Board of Agriculture and Fisheries desire to bring to the notice of farmers in England and Wales the arrangements which, in view of the shortage of agricultural labour, have been made by the Army Council for the employment of soldiers on farm work at any season of the year (except during the corn harvest).

Employers of Soldiers as distinct from Convalescents.

1. Furlough will be given at the discretion of the Military Authorities, and as circumstances may permit, to a limited number of soldiers serving at home who have been accustomed to work on farms.

2. The furlough granted to each soldier will last only for such number of days not exceeding 4 weeks, as he is actually required for the work.

The employment of soldiers will be subject to the following conditions :—

(*a*) That suitable labour cannot be obtained in the locality,

(*b*) That the farmer will undertake to pay each soldier sent at his request :—

(i.) 4*s*. a day if the soldier provides his own board and lodging.

(ii.) 2*s*. 6*d*. a day if board and lodging is provided by the farmer.

The hours worked to be those customary in the district.

(*c*) That the farmer will provide conveyance from and to the nearest railway station.

The above rates to be inclusive of all allowances, and to be paid, wet or fine.

No charge will be made to the farmer for railway travelling expenses.

3. Application may be made for men for any class of farm work, and the nature of the work should be specified on the form of application, to enable the Commanding Officer to select a suitable man so far as is possible.

4. Every endeavour will be made to ensure that the men released have been accustomed to the farm work indicated in the application, but no guarantee to this effect can be given, and if a farmer wants his son, or one of his former labourers who is serving at home, efforts will be made to arrange accordingly.

5. Applications from farmers who desire to employ soldiers must be made as soon as possible to the Board of Trade Labour Exchanges, when the application will be transmitted to the Military Authorities. Forms for the purpose will be supplied by the Local Labour Exchange, the address of which can be obtained from the nearest Post Office.

6. In the case of a farmer living in the neighbourhood of a military station, he may apply direct to a Commanding Officer for military labour which he requires at short notice, and for a period not exceeding 6 working days. This arrangement may enable the farmer to take advantage of fine days or short intervals of fine weather suitable for his work.

7. The above arrangements do not apply to the release of soldiers for the corn harvest, as to which a further notice will be issued in due course.

Employment of Convalescent Soldiers.

8. The Army Council have arranged that convalescents at Infantry Depots, Command Depots and Convalescent Hospitals, may be employed temporarily on agricultural work within easy reach of where they are stationed.

9. Applications from farmers who desire to employ such soldiers should be made as indicated in paragraph 5 above, but in the case of a farmer living in the neighbourhood of the man's military station requiring a man at short notice, the farmer may apply direct to the Officer Commanding the depot or hospital.

10. In making application, the farmer must state clearly the exact nature of the employment in order that the Military Authorities may be in a position to decide whether a soldier is capable of undertaking the work he would be called upon to do.

11. For the purpose of such employment, soldiers will be granted sick furlough, which will be liable to be cancelled forthwith, if at any time a man's health so improves that he is fit for discharge from the depot or hospital, or if his health is suffering from the work.

12. The soldier may either live away from the depot or hospital, or go to his work daily from his military quarters.

13. The cost, if any, of moving the man to or from his work must be borne by the farmer, except that no charge will be made to the farmer for railway travelling expenses, if the man is to be employed for a week or more at a distance of 20 miles, or over, by rail, or if the man is to be away at least 3 days at a distance by rail of less than 20 miles.

14. The employment will be subject to the following conditions :—

(a) That suitable labour cannot be obtained in the locality.

(b) That if the soldier goes away from his military station, the farmer will undertake to pay each soldier sent at his request :—

(i.) 3s. 6d. a day if the soldier provides his own board and lodging.

(ii.) 2s. a day if board and lodging is provided by the farmer.

The hours worked to be those customary in the district.

(c) That one rest day must be allowed by the farmer in every seven days, for which the soldier will receive Army pay.

(d) That if the soldier goes and returns each day to his depot or hospital, the farmer will undertake to pay the soldier at the rate of 3d. per hour, including hours for meals. In such a case at least one good meal must be provided by the farmer, if the honrs of work are such as to prevent the soldier returning to his unit for his midday meal. The payment referred to will be made weekly by the farmer to the Officer Commanding the depot or hospital.

(e) That the farmer will provide conveyance from and to the nearest railway station.

15. The above rates of pay will be inclusive of all allowances except as regards the midday meal referred to, and must be paid, wet or fine.

The following circular, dated 22nd January, 1916, has been addressed by the Board to the Secretaries of the County War Agricultural Committees :—

Increased Production of Food during the War.

SIR,—1. Lord Selborne has received many suggestions from Lord Milner's Committee and other sources, of methods by which the production of food in this country during the war can be maintained and increased. He is well aware that these suggestions have probably already been considered by your Committee, but he thinks it due to the willing help of those from whom they emanate that he should circulate them. They are obviously unequal in importance, but their aggregate value is considerable.

2. Lord Milner's Committee expressed the hope that the consent of landowners to the breaking up of grass land for the purpose of growing

wheat or making more room for wheat on arable land should not be withheld, notwithstanding the existence of restrictive covenants in leases. If any cases come to your Committee's notice of such consent being unreasonably withheld perhaps they may find means to bring the recommendation of the Departmental Committee to the notice of the landowner concerned, and to use their good offices to obtain his consent to the waiving of restrictions which may have been framed in normal times to meet normal conditions.

3. The making and planting of osier beds under suitable conditions is often a profitable undertaking, and can be done on land of but little use for other purposes. In circumstances of this kind your Committee might appeal to landowners, where necessary, not to refuse the consent which is required under the Agricultural Holdings Act, 1908, to establish the tenant's right on quitting, to claim compensation, and which is an essential preliminary to justify a tenant undertaking the trouble and expense involved in producing osiers for the basket-making industry of this country. It is really important that as many baskets as possible should be produced at home, and as few as possible imported.

4. Lord Milner's Committee recommended also that owners should consider the use being made of their moorlands, with the object of ensuring that they are stocked with as many sheep as the land can carry. The Committee accompanied their recommendation with an expression of opinion that owing to the differences in local conditions no general rule could be laid down as to the proportion which should exist between the number of sheep and the acreage of moorland, but they expressed the belief that not infrequently permission might safely be given, as a temporary measure, to pasture more sheep than are normally kept on moors without any harm resulting.

5. The Committee also recommended that parks and golf courses should be used to their maximum capacity for grazing stock.

6. Attention has been drawn to the opportunities which local authorities, land owners, and other residents may possess of helping farmers by releasing as many of their employees as possible for work on the land. This has certainly been done in very many instances, but the value to the farmer of the occasional assistance of game keepers, woodmen, roadmen, garden labourers, and men of that class, most of whom possess some practical knowledge of farm work, can hardly be over-estimated at a time when the shortage of skilled farm hands is necessarily so acute.

7. From reports which Lord Selborne has received from different parts of the country it would seem that in some cases farmers are prevented from using their land in the manner most profitable to the community by damage or the fear of damage by game and rabbits.

8. For various reasons pheasant rearing was, to a great extent, abandoned or restricted last season, and next season this may be found to be even more generally the case, but if any instance should be brought to the notice of your Committee of pheasant rearing on any considerable scale, Lord Selborne hopes that your Committee will appeal in his name to the landowner or shooting tenant to subordinate his personal interests to those of the community, which clearly require at the present time the production at home of as great a supply of food as the land can be made to produce.

9. Lord Selborne realises that it is difficult for landowners or tenants at the present time to provide the labour necessary for keeping down

the stock of rabbits, but he trusts that your Committee will do all they can to promote co-operation between the landowner and the tenant in dealing with this matter with a view to effecting the maximum destruction of rabbits with the minimum of labour.

10. I am, further, to suggest that your Committee should bring to the notice of the Urban District Councils in your County the possibility of utilising spare building and other vacant plots for the purpose of growing vegetables and similar crops.

11. I am to enclose, for the information of your Committee, two copies of a letter [not printed], which Lord Selborne has addressed to the Mayors of County Boroughs and Boroughs in England and Wales with regard to the provision and cultivation of allotments.

12. I am also to enclose 50 copies of a list of leaflets issued by the Board, and I am to suggest that you should send a copy to the Secretaries of each of the District Committees set up in your County, for their information.

I am, &c.,

SYDNEY OLIVIER, *Secretary*.

Spread of Disease from Army to Agricultural Horses.

REPRESENTATIONS have been made to the Board of Agriculture and Fisheries that a number of cases of disease amongst agricultural horses have been due to contact with military horses, or to the presence of such horses in the locality.

While the conditions prevailing in war render it almost impossible to prevent isolated cases occurring in which disease is so spread, it cannot be overlooked that even in normal times equine diseases are by no means infrequent in this country.

The Army Council have issued instructions that the utmost care is to be taken to obviate possible injury to agricultural and other horses by the presence of infected military horses, but absolute immunity from such injury cannot be effected unless agricultural and other horse owners themselves render assistance.

The President of the Board of Agriculture and Fisheries therefore desires to impress on agriculturists the great importance of taking all possible steps to prevent the spread of disease and to co-operate with the military authorities as closely as possible to achieve this object.

Committee on the Settlement and Employment on the Land of Discharged Sailors and Soldiers.

THE President of the Board of Agriculture and Fisheries has appointed the Right Hon. Henry Hobhouse to be Chairman of the Departmental Committee on the Settlement and Employment on the land of Discharged Sailors and Soldiers, in the place of Sir Harry Verney, Bart., M.P., who has received a Commission in the Army; and he has appointed the Hon. E. G. Strutt, and Sir Luke White, M.P., to be additional members of the Committee; Mr. H. L. French, of the Board of Agriculture and Fisheries, has been appointed Secretary to the Committee.

The Committee, which was appointed by Lord Selborne in July last, have presented the First Part of their Report dealing with Settlement, a summary of which will be found on p. 1166. They are now considering the Second Part, which will deal with Employment.

KINGDOM,* 1915.

Acreage and Production of Crops.

Crops.	Acreage.		Produce.**		Yield per acre.		Average yield per acre of 10 years.
	1915.	1914.	1915.	1914.	1915.	1914.	1905-14.
Total Area (excluding water)	Acres. 76,455,346.		—		—		—
Total Acreage of Crops and Grass†	46,554,185	46,642,951	—		—		—
Arable Land	19,254,512	19,320,823	—		—		—
Permanent Grass—			Tons.	Tons.	Cwt.	Cwt.	Cwt.
For Hay	6,393,365	6,489,885	7,922,591	8,192,555	24·73	25·25	28·27
Not for Hay ..	20,906,308	20,832,243	—	—	—	—	—
Total	27,299,673	27,322,128	—	—	—	—	—
			Quarters.	Quarters.	Bush.	Bush.	Bush.
Wheat	2,333,354	1,904,932	9,239,355	7,804,041	31·68	32·77	32·35
Barley or Bere ..	1,522,654	1,871,169	5,862,244	8,065,678	30·80	34·48	34·38
Oats	4,159,312	3.877,964	22,308,395	20,663,537	42·91	42·63	42·12
Rye	59,934	66,783	—	—	—	—	—
‡Beans	272,929	301,375	924,155	1,120,078	28·00	30·72	30·52
‡Peas	130,226	169,804	300,338	374,038	24·38	23·02	26·39
			Tons.	Tons.	Tons.	Tons.	Tons.
Potatoes	1,202,259	1,197,008	7,540,240	7,476,458	6·27	6·25	5·73
Turnips and Swedes ..	1,617,973	1,752,574	24,431,083	24,195,755	15·13	13·83	14·56
Mangold	498,954	515,864	9,696,499	9,522,921	19·48	18·50	19·41
Cabbage, Koh-rabi and Rape	183,844	191,343	—	—	—	—	—
§Vetches or Tares ..	123,389	137,447	—	—	—	—	—
			Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
Hops	34,744	36,661	254,609	507,258	7·33	13·84	9·73
¶Small Fruit	97 126	100,719	—	—	—	—	—
Clover and Rotation Grasses—			Tons.	Tons.			
For Hay	2,837,030	2,902,902	4,526,192	4,210,924	31·91	29·01	32·05
Not for Hay ..	3,583,943	3,659,688	—	—	—	—	—
Tota	6,420,973	6,562,590	—	—	—	—	—
Other Crops	280,228	286,625	—	—	—	—	—
Bare Fallow	316,613	347,965	—	—	—	—	—

Live Stock.

—	1915.	1914.
	No.	No
Horses used for Agricultural Purposes (including Mares kept for breeding)	1,217,880	1,320,466
Unbroken Horses, including Stallions — One year and above	319,159	350,362
Unbroken Horses, including Stallions — Under one year ..	166,581	171,729
Total Horses	1,703,620	1,842,557
Cows and Heifers in Milk or in Calf	4,476,788	4,576,852
Other Cattle .. — Two years and above	2,218,246	2,326,584
Other Cattle .. — One year and under two	2,656,053	2,587,853
Other Cattle .. — Under one year	2,780,795	2,653,274
Total Cattle	12,131,882	12,144,563
Ewes kept for breeding	11,308,451	11,221,604
Other Sheep .. — One year and above	5,390,746	5,037,911
Other Sheep .. — Under one year	11,499,245	11,626,580
Total Sheep	28,198,442	27,886,095
Sows kept for breeding	437,828	492,981
Other Pigs	3,346,505	3,446,906
Total Pigs	3,784,333	3,939,887

* Exclusive of the Isle of Man and Channel Islands, where no produce statistics are collected.
** The figures of Produce for Ireland are subject to revision.
† Exclusive of Mountain and Heath land used for grazing.
‡ Figures include acreage, but not produce of areas picked or cut green, excep tin the case of beans in Scotland, where the acreage picked or cut green is excluded.
§ Figures for Scotland include beans, mashlum, etc., for fodder.
¶ Figures for Ireland include orchards.

MISCELLANEOUS NOTES.

Notes on Crop Prospects and Live Stock Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for January, 1916, issued by the International Iustitute of Agriculture, shows the production of cereal crops during the past year. The countries for which it is possible to give an approximate estimate are as follows:—In *Europe*—Hungary (proper), Bulgaria, Denmark, Spain, France, Great Britain, Ireland, Italy, Luxemburg, Norway, Netherlands, Rumania, Russia in Europe (54 governments), Switzerland; in *America*—Canada, United States; in *Asia*—India, Japan, Russia in Asia (10 governments in 1915 and 9 governments in 1914); in *Africa*—Egypt, Tunis.

Wheat.—In the above couutries the production is estimated to amount to 460,047,000 qr. in 1915, against 374,959,000 qr. in 1914, or an increase of 22·7 per cent. By the addition of the production for Argentina and Australia a figure is obtained which may be taken to approximately represent the world's production of wheat, viz.:—*500,931,000 qr. in 1915-16, against 399,117,000 qr. in 1914-15, an* increase of 25·5 per cent.

Rye.—The total production in the aforementioned countries, excluding Great Britain, India, Japan, Egypt, and Tunis, is estimated at 138,568,000 qr. in 1915, compared with 120,208,000 qr. in 1914, an increase of 15·3 per cent.

Barley.—The production in the specified countries, with the exception of India, is estimated to approximate to 148,323,000 qr. in 1915, against 126,345,000 qr. in 1914, an increase of 17·4 per cent.

Oats.—The total production in the above countries, excluding India, Japan, and Egypt, is placed at 404,726,000 qr. in 1915, against 322,300,000 qr. in 1914, an increase of 25·6 per cent. The combined total for these countries and Argentina, which may be taken to approximate to the world's production, amounted to 411,953,000 qr. in 1915-16, against 328,171,000 qr. in 1914-15, an increase of 25·5 per cent.

Maize.—In Hungary, Italy, Rumania, Russia in Europe (54 Governments), Switzerland, Canada, United States, Japan, and Russia in Asia (10 governments in 1915 and 9 governments in 1914), the total production is estimated at 413,489,000 qr. in 1915, against 368,397,000 qr. in 1914, an increase of 12·2 per cent.

France.—According to the preliminary official report the areas sown with winter grain up to the 1st January were as follows:—Wheat, 12,400,000 acres as compared with 13,600,000 acres in the previous year; rye, 2,300,000 acres against 2,600,000 acres; oats, 1,700,000 acres against 1,900,000 acres; and barley, 250,000 acres against 370,000 acres. The condition of wheat on the 1st January was 69, rye 68, barley 71, and oats 71 (100 = very good, 80 = good, 60 = fairly good).—(*The London Grain, Seed and Oil Reporter*, 24th January.)

Russia.—According to an official report the condition of the autumn-sown crops of rye, wheat and barley, on the 29th November, was extremely favourable. In only one (Ural) of the 62 governments and provinces from which reports were received, were the crops considered below average, whilst 6 per cent. of the governments reported satisfactory, and 92 per cent. above average crops.—(*Broomhall's Corn Trade News*, 12th January.)

Canada.—According to the final returns of the Census and Statistics

bush. as compared with 161,280,000 bush. in 1914; oats, 520,103,000 bush. against 313,078,000 bush.; barley, 53,331,300 bush. against 36,201,000 bush.; linseed, 10,628,000 bush. against 7,175,200 bush.; and maize, 14,368,000 bush., against 13,924,000 bush. in 1914.

India.—The first Government forecast of the area under wheat, based on reports received from all the important wheat-growing areas, except Indore and Bhopal, and six states of comparatively small importance in Rajputana, states that the area sown up to the end of November last was 27,604,000 acres as compared with 28,852,000 acres last year, or a decrease of 4 per cent. The sowing season has, on the whole, been quite favourable, except in the western and south-eastern Punjab, the western districts of the United Provinces, in Gujarat, Sind, and in parts of the North-West Frontier Province and Rajputana. In these districts the rainfall was deficient. The condition and prospects of the crop are reported to be, on the whole, from fair to good, but rain was urgently required in the Punjab and in the western districts of the United Provinces at the date of the reports. The rain which fell in parts of these districts on the 15th December must, however, have benefited the crop.

Argentina.—According to the first official forecast the production of wheat is estimated at 23,013,000 qr. as compared with 21,053,000 qr. in 1914-15; oats, 7,735,000 qr. against 5,870,000 qr.; and linseed, 5,420,000 qr. against 5,963,000 qr. last year. (*Bulletin of Agricultural and Commercial Statistics*, January, 1916.)

The weather during the last week of December and first fortnight of January was fine and warm, and very favourable for harvesting and threshing operations. The hot sun and hot winds of the second week of January did some damage to the ripening maize, particularly in the provinces of Cordoba and Santa Fe, where the effects of the drought are beginning to cause some justifiable alarm. Damage by locusts is also being felt in these provinces and in Entre Rios, and there is reason to fear that an appreciable proportion of the maize crop has been lost in some districts of the province of Cordoba as a result of the drought and locusts. It is still hoped, however, that the final general results for this crop will be satisfactory. (*The Review of River Plate*, 14th January.)

Live Stock in United States.—The Crop Reporting Board of the United States Department of Agriculture estimates that the number of horses in that country, on the 1st January, was 21,166,000, as compared with 21,195,000 on the 1st January, 1915; milch cows, 21,988,000 against 21,262,000; other cattle, 39,453,000 against 37,067,000; sheep, 49,162,000 against 49,956,000; and pigs, 68,047,000 against 64,618,000 a year ago.

Live Stock in New Zealand.—The Annual Sheep Returns for New Zealand for the year ended 30th April, 1915, show a total of 24,901,421 sheep, against 24,798,763 in 1914, or an increase of 0·4 per cent. (*Bulletin of Agricultural and Commercial Statistics, Jan.,* 1916.)

Agricultural Conditions in England and Wales on 1st February.

THE Crop Reporters of the Board, in reporting on the agricultural position on 1st February, state that January generally proved mild and open, and enabled good progress to be made in cultivating the ground; much of the arrears caused by the wet December being thus overtaken, while some more wheat was put in. In Wales and the north-west, however, the weather was more stormy, and work was greatly hindered. The

early sown wheat is looking very well everywhere; while the late sown, although still weaker and more backward than the first sowings, has greatly benefited by the mild weather, and is generally much more satisfactory than a month ago. Other autumn-sown crops are also healthy and satisfactory generally, though some are still backward.

There seems to be no scarcity of locally grown seed-potatoes, but those growers who usually obtain their seed from Scotland or Ireland are placing their orders early for fear of possible delays on the railway, and it would be advisable for others who get their seed from a distance to order in good time.

In the north ewes, owing to the long period of wet weather, are not considered to be up to the average in condition; but elsewhere they are stronger, and lambing prospects are reported on favourably. The Dorset Horn flocks have finished lambing, with a satisfactory fall, and progress among the early Down flocks in the south is also generally good, except perhaps in the Isle of Wight.

Live stock generally have done quite well during the month, many having been turned out into the open, which has enabled farmers to husband their supplies of roots and hay. These are, in many districts, somewhat short, but the mild weather has been of great benefit, and unless a prolonged cold spell sets in there should be about sufficient for reqnirements during the remainder of the winter.

Agricultural Labour in England and Wales during January.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st February, the supply of labour was everywhere decidedly deficient, and much apprehension was felt as to the prospects of getting through the heavy work of the spring. The conditions in the different districts were as follows:—

Northumberland, Durham, Cumberland and Westmorland.—Farm workers were very scarce throughout the division. At the Candlemas hirings in Cumberland very few men were on offer, and wages were very high.

Lancashire and Cheshire.—Labour was very scarce, and the difficulty in this respect is likely to become greater shortly, when the demand increases.

Yorkshire.—The supply of labour was very deficient, and wages were being increased in some districts. Horsemen seemed to be very scarce in some parts of the county.

Shropshire and Stafford.—The supply of labour was very scarce and farmers were becoming anxious.

Derby, Nottingham, Leicester and Rutland.—The supply of labour was still deficient, and there was very little prospect of improvement.

Lincoln and Norfolk.—The supply of labour was very short throughout the division, and women were being employed in some districts.

Suffolk, Cambridge and Huntingdon.—There was a short supply of labour in all districts, and it was expected to be keenly felt when the heavy spring work begins.

Bedford, Northampton, and Warwick.—Labour was deficient, and wages had risen in one or two districts.

Buckingham, Oxford, and Berkshire.—Labour was very short, and fears were expressed that the shortage will become serious later, when

reported to be difficult to arrange for, but neighbouring farmers were trying to ease matters by assisting one another.

Worcester, Hereford, and Gloucester.—There was a very short supply of labour throughout the division, and wages tended to increase.

Cornwall, Devon, and Somerset.—The supply of labour was still short for every class of farm work.

Dorset, Wiltshire, and Hampshire.—With lambing going on and the land fit to work, the shortage in the supply of labour was increasingly felt, and farmers were experiencing difficulty in getting their work done in some districts. Throughout the division labourers were scarce.

Surrey, Kent and Sussex.—Generally speaking, the supply of labour was still deficient, especially as regards horsemen. It was anticipated that the shortage will be more seriously felt in the future.

Essex, Hertford and Middlesex.—The supply of labour was very short, and farmers anticipated great difficulty in getting the spring work done.

North Wales.—The supply of labour during January was about sufficient in some districts, but short in others

Mid Wales.—The supply of labour continued to decrease, and in most parts of the division was very deficient.

South Wales.—There is no change to record in the position this month. The shortage of labour was very pronounced, and no relief was obtained from the assistance of women.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st February, 1916, certain diseases of animals existed in the countries specified :—

Austria (on the 12th Jan.).

Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (month of Dec.).

Anthrax, Foot-and-Mouth Disease (275 outbreaks), Glanders and Farcy, Swine Erysipelas, Swine Fever.

France (for the period 2nd—15th Jan.).

Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-scab, Swine Erysipelas, Swine Fever.

Germany (for the period 1st—15th Jan.).

Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (month of Dec.).

Anthrax, Foot-and-Mouth Disease (147 outbreaks), Foot-rot, Swine Erysipelas.

Hungary (on the 12th Jan.).

Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox, Swine Erysipelas, Swine Fever.

Italy (for the period 3rd—9th Jan.).

Anthrax, Foot-and-Mouth Disease (2,873 outbreaks), Glanders, and Farcy, Rabies, Sheep-scab, Swine Fever, Tuberculosis.

Russia (month of Aug.).
Anthrax, Foot-and-Mouth Disease (324,017 animals), Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (month of Oct.).
Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (month of Dec.).
Anthrax, Foot-and-Mouth Disease (6 outbreaks), Swine Erysipelas.

Switzerland (for the period 1st—9th Jan.).
Anthrax, Blackleg, Foot-and-Mouth Disease (28 "étables" entailing 654 animals, of which 6 "étables" were declared infected during the period), Glanders, Swine Fever.

No further returns have been received in respect of the following countries:—Belgium, Bulgaria, Montenegro, Serbia.

The Weather in England during January.

District.	Temperature.		Rainfall.				Bright Sunshine.	
	Daily Mean.	Diff. from Average.	Amount.		Diff. from Average.	No. of Days with Rain.	Daily Mean.	Diff. from Average.
	°A.*	°A.*	In.	Mm.†	Mm.†		Hours.	Hours.
Week ending Jan. 8th:	200+							
England, N.E. ...	81·2	+5·0	0·18	5	− 6	3	1·8	+0·7
England, E.	81·4	+5·5	0·83	21	+10	5	1·2	−0·1
Midland Counties ...	81·4	+5·5	0·59	15	+ 1	5	1·4	+0·2
England, S.E.... ...	81·9	+5·0	0·57	15	+ 1	5	1·3	−0·1
England, N.W. ...	81·6	+4·7	0·91	23	+ 6	6	1·2	+0·2
England, S.W. ...	82·0	+4.0	1·17	30	+ 7	6	1·7	+0·2
English Channel ...	83·0	+5·1	0·34	9	−11	5	1·9	0·0
Week ending Jan. 15th:								
England, N.E.... ...	78·9	+2·5	0·15	4	− 8	2	1·5	+0·4
England, E.	78·6	+2·7	0·15	4	− 6	3	2·0	+0·6
Midland Counties ...	79·3	+3·3	0·10	3	− 9	3	1·4	+0·1
England, S.E.... ...	79·4	+2·5	0·11	3	−10	3	1·8	+0·3
England, N.W. ...	80·2	+2·9	0·32	8	− 8	5	0·6	−0·5
England, S.W. ...	80·7	+2·7	0·17	5	−15	3	0·5	−1·0
English Channel ...	81·7	+1·9	0·21	5	−13	3	1·2	−0·8
Week ending Jan. 22nd:								
England, N.E. ...	80·8	+4·0	0·21	6	− 4	4	2·0	+0·6
England, E.	81·0	+4·6	0·46	12	+ 3	4	1·4	−0·2
Midland Counties ...	80·8	+4·3	0·31	8	− 3	4	1·7	+0·3
England, S.E	81·2	+3·9	0·52	13	+ 1	6	1·0	−0·6
England, N.W. ...	81·2	+3·8	0·95	24	+ 7	5	1·7	+0·5
England, S.W. ...	81·4	+3·1	0·85	22	+ 2	6	1·7	+0·1
English Channel ...	82·4	+2·5	0·52	13	− 3	7	1·5	−0·5
Week ending Jan. 29th:								
England, N.E. ...	79·6	+2·5	0·13	3	− 6	1	1·7	0·0
England, E.	79·5	+2·7	0·05	1	− 9	1	2·4	+0·4
Midland Counties ...	79·8	+2·9	0·07	2	−11	2	1·8	+0·1
England, S.E.... ...	80·5	+2·9	0·06	2	−11	2	2·4	+0·6
England, N.W. ...	80·4	+2·8	0·46	12	− 7	4	1·2	−0·2
England, S.W. ...	80·7	+2·2	0·21	6	−16	3	1·9	+0·1
English Channel ...	81·7	+1·6	0·13	3	−14	4	2·4	+0·2

* 273° A. (Absolute) = 0° C. = 32° F.: increment of 1°A. = increment of $\frac{9}{5}$°F.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	JANUARY.	
	1916.	1915.
Anthrax:—		
Outbreaks	63	88
Animals attacked	*65*	*100*
Foot-and-Mouth Disease:—		
Outbreaks	—	—
Animals attacked	—	—
Glanders (*including Farcy*):—		
Outbreaks	6	3
Animals attacked	24	5
Parasitic Mange:—		
Outbreaks	490	†—
Animals attacked	1,338	†—
Sheep-Scab:—		
Outbreaks	97	79
Swine Fever:—		
Outbreaks	385	407
Swine Slaughtered as diseased or exposed to infection	1,244	1,782

* Figures for nine months only. † The Parasitic Mange Order of 1911 was suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	JANUARY.	
	1916.	1915.
Anthrax:—		
Outbreaks	1	—
Animals attacked	5	—
Foot-and-Mouth Disease:—		
Outbreaks	—	—
Animals attacked	—	—
Glanders (*including Farcy*):—		
Outbreaks	—	—
Animals attacked	—	—
Parasitic Mange:—		
Outbreaks	9	5
Sheep-Scab:—		
Outbreaks	85	69
Swine Fever:—		
Outbreaks	18	20
Swine Slaughtered as diseased or exposed to infection	37	99

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in January, 1916, and December, 1915.

(*Compiled from Reports received from the Board's Market Reporters.*)

Description.	January.		December.	
	First Quality.	Second Quality.	First Quality.	Second Quality.
FAT STOCK :—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle :—	s. d.	s. d.	s. d.	s. d.
Polled Scots	11 4	11 1	11 4	10 10
Herefords	11 2	10 2	11 1	10 1
Shorthorns	11 3	10 4	11 0	9 11
Devons	11 5	10 3	11 2	9 11
Welsh Runts	11 0	10 5	10 8	9 11
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	10	9	9¾	8½
Sheep :—				
Downs	11¾	10½	11	10
Longwools	11	10	10½	9½
Cheviots	11¾	10¾	11	10
Blackfaced	11½	10¼	10¾	9½
Welsh	10¼	9½	10	9
Cross-breds	11½	10½	10¾	9¾
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs :—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	10 7	9 11	10 6	9 10
Porkers	11 6	10 10	11 4	10 8
LEAN STOCK :—	per head.	per head.	per head.	per head.
Milking Cows :—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	29 12	24 2	29 19	24 10
,, —Calvers ...	29 1	23 0	28 7	23 6
Other Breeds—In Milk ...	28 0	24 2	29 2	23 18
,, —Calvers ...	21 10	19 10	—	20 0
Calves for Rearing	2 15	2 2	2 15	2 2
Store Cattle :—				
Shorthorns—Yearlings ...	12 15	10 16	12 7	10 7
,, —Two-year-olds...	17 5	15 3	16 14	15 3
,, —Three-year-olds	22 14	19 7	23 0	19 5
Herefords —Two-year-olds...	19 0	15 7	19 1	15 14
Devons— ,,	18 4	16 0	17 17	16 7
Welsh Runts— ,,	17 7	—	16 15	15 14
Store Sheep :—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	53 6	45 7	49 8	42 11
Store Pigs :—				
8 to 12 weeks old	25 8	18 9	24 2	18 2
12 to 16 weeks old	44 7	34 4	43 10	33 4

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in January, 1916.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham.		Leeds.		Liverpool.		London.		Manchester.	
		per cwt.		per cwt.		per cwt.		per cwt.		per cwt.	
		s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
BEEF:—											
English	1st	76	0	73	6	—		76	6	73	0
	2nd	71	0	69	6	—		72	0	70	6
Cow and Bull	1st	69	0	68	0	64	0	67	0	67	0
	2nd	63	0	63	0	59	0	62	6	62	6
Irish: Port Killed	1st	71	0	71	6	72	6	74	6	70	6
	2nd	70	0	69	6	67	6	69	6	66	0
Argentine Frozen—											
Hind Quarters	1st	71	6	—		70	0	—		70	0
Fore ,, ...	1st	63	0	—		—		—		—	
Argentine Chilled—											
Hind Quarters	1st	84	6	78	0	82	6	81	6	82	6
Fore ,, ...	1st	60	6	55	0	61	6	60	6	61	6
Australian Frozen—											
Hind Quarters	1st	63	6	—		67	6	—		67	6
Fore ,, ...	1st	53	6	—		59	0	—		59	0
VEAL:—											
British	1st	—		—		—		105	0	—	
	2nd	88	6	—		—		95	6	—	
Foreign...	1st	—		—		—		109	6	—	
MUTTON:—											
Scotch	1st	93	6	88	6	98	6	95	6	98	6
	2nd	86	6	84	0	92	0	89	0	94	0
English...	1st	92	0	93	6	—		87	6	93	6
	2nd	87	0	88	6	—		82	0	88	6
Irish: Port Killed	1st	89	0	—		90	6	84	6	88	6
	2nd	87	0	—		81	6	79	6	84	0
Argentine Frozen	1st	71	0	71	0	69	6	70	0	69	6
Australian ,, ...	1st	66	6	69	6	69	0	65	6	69	0
New Zealand ,, ...	1st	69	0	70	0	—		72	6	—	
LAMB:—											
British	1st	—		—		—		—		—	
	2nd	—		—		—		—		—	
New Zealand	1st	76	6	74	0	76	6	75	0	76	6
Australian	1st	71	6	—		71	6	71	0	72	6
Argentine	1st	73	6	74	6	73	0	71	6	72	6
PORK:—											
British	1st	95	6	94	6	98	0	98	0	97	0
	2nd	88	6	90	6	88	6	88	6	91	0
Frozen	1st	71	6	76	0	75	0	74	0	74	6

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in January, 1916.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Bristol.		Liverpool.		London.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER :—	per 12 lb	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	19 0	17 9	—	—	19 0	18 0
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	—	—	—	—	—	—
" Factory	134 0	127 0	134 0	126 0	—	—
Danish...	—	—	160 6	157 6	158 6	154 0
French...	—	—	—	—	164 0	158 0
Russian	130 0	122 0	—	124 0	131 0	123 6
Canadian...	150 0	146 0	148 6	144 6	—	—
Australian	151 6	148 0	151 0	148 0	155 6	149 6
New Zealand	154 0	151 6	154 6	151 6	158 6	152 6
Argentine	150 0	146 0	149 0	146 0	151 6	144 6
CHEESE :—						
British—						
Cheddar	101 6	95 6	103 0	100 6	103 0	97 0
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	113 6	109 6	117 6	109 0
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	97 6	95 0	98 0	94 6	99 0	96 6
BACON :—						
Irish (Green)	105 0	98 0	103 6	99 6	106 0	100 6
Canadian (Green sides)	91 0	86 6	91 0	87 0	93 0	88 0
HAMS :—						
York (Dried or Smoked)	150 0	142 0	—	—	148 0	139 0
Irish (Dried or Smoked)	—	—	—	—	143 0	137 0
American (Green) (long cut)	90 0	88 0	92 0	87 6	91 0	87 6
EGGS :—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British...	19 4	—	—	—	22 6	21 0
Irish	20 10	—	21 7	20 1	21 4	20 0
American	16 2	—	15 7	14 9	16 7	15 7
POTATOES :—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
British Queen ...	100 0	85 0	—	—	110 0	100 0
Edward VII.	116 0	105 0	80 0	76 6	106 6	100 0
Up-to-date	101 0	90 0	75 0	70 0	106 0	96 6
HAY :—						
Clover	—	—	170 0	130 0	137 6	130 0
Meadow	—	—	—	—	133 0	124 6

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1914, 1915 and 1916.

Weeks ended (*in* 1916).	Wheat. 1914.	Wheat. 1915.	Wheat. 1916.	Barley. 1914.	Barley. 1915.	Barley. 1916.	Oats. 1914.	Oats. 1915.	Oats. 1916.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Jan. 8...	30 11	46 2	55 8	25 11	29 7	47 8	18 4	26 5	31 5
" 15...	31 0	48 9	56 7	26 0	30 5	48 6	18 6	27 6	31 11
" 22...	30 11	51 6	57 2	26 3	31 3	49 6	18 11	28 10	32 6
" 29...	31 1	52 8	58 0	26 6	32 5	51 0	19 1	29 10	32 11
Feb. 5...	31 0	53 3	58 3	26 7	33 7	52 5	18 9	30 3	32 4
" 12...	31 0	54 8		26 7	34 7		18 11	31 1	
" 19...	31 0	56 0		26 7	34 11		18 11	31 5	
" 26...	31 0	56 0		26 6	35 3		18 11	31 8	
Mar. 4...	31 5	55 11		26 2	34 6		18 9	31 8	
" 11...	31 6	54 8		26 0	33 5		18 7	31 0	
" 18...	31 5	53 9		25 8	32 2		18 6	30 7	
" 25...	31 4	54 3		25 7	31 11		18 8	30 6	
Apl. 1...	31 6	54 6		25 6	31 9		18 5	30 6	
" 8...	31 5	54 9		26 8	31 3		18 4	30 4	
" 15...	31 7	55 4		25 4	30 10		18 4	30 5	
" 22...	31 9	56 5		26 6	31 5		18 5	30 11	
" 29...	31 9	58 3		26 0	32 7		18 5	31 5	
May 6...	32 2	60 5		25 6	33 3		18 9	32 4	
" 13...	32 7	61 7		26 3	34 0		18 11	32 5	
" 20...	33 0	62 0		25 10	34 1		19 0	32 8	
" 27...	33 9	61 11		26 1	34 8		19 4	32 7	
June 3...	34 0	61 9		25 11	35 4		19 4	32 5	
" 10...	34 1	60 1		24 11	34 5		19 8	32 4	
" 17...	34 1	56 1		25 10	34 3		19 9	31 9	
" 24...	34 3	52 0		25 4	34 4		20 0	31 9	
July 1...	34 4	49 5		24 6	35 3		19 9	31 1	
" 8...	34 2	50 1		24 9	34 7		20 0	31 6	
" 15...	34 1	52 7		24 2	35 8		19 10	31 6	
" 22...	34 0	53 10		24 7	35 10		19 9	32 1	
" 29...	34 2	55 3		25 9	36 1		19 8	31 1	
Aug. 5...	34 9	55 4		25 2	35 7		19 1	31 5	
" 12...	40 3	55 2		29 4	37 0		25 1	31 7	
" 19...	38 9	54 3		29 10	39 4		24 3	31 4	
" 26...	36 2	51 11		30 3	38 3		23 5	30 0	
Sept. 2...	36 5	45 3		30 6	38 1		23 9	26 10	
" 9...	37 10	43 0		29 11	37 11		23 11	26 8	
" 16...	38 3	42 9		29 5	39 0		23 8	26 4	
" 23...	37 6	43 3		29 3	39 8		23 3	26 1	
" 30...	37 1	43 5		29 1	40 4		22 9	26 5	
Oct. 7...	36 8	44 1		28 10	41 0		22 5	26 5	
" 14...	36 7	45 9		28 8	42 3		22 4	27 1	
" 21...	37 2	48 2		28 7	44 0		22 5	28 1	
" 28...	37 10	50 3		28 3	46 2		23 7	29 1	
Nov. 4...	38 8	51 6		28 6	47 3		23 7	30 4	
" 11...	39 8	52 8		29 0	47 5		24 8	30 11	
" 18...	41 0	53 6		29 8	47 11		25 5	31 3	
" 25...	41 11	54 2		30 3	48 7		25 8	31 1	
Dec. 2...	42 2	53 7		30 2	48 11		25 9	30 11	
" 9...	42 1	52 10		29 11	47 10		25 9	30 4	
" 16...	42 7	53 11		29 8	47 5		25 9	30 6	
" 23...	43 3	53 10		29 9	47 2		25 11	30 7	
" 30...	44 4	54 9		29 10	47 5		26 6	30 10	

NOTE. Returns of purchases by weight or weighed measure are converted to

AVERAGE PRICES of **British Wheat, Barley,** and **Oats** at certain Markets during the Month of January, 1914, 1915, and 1916.

—	Wheat.						Barley.						Oats.					
	1914.		1915.		1916.		1914.		1915.		1916.		1914.		1915.		1916.	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
London ...	32	2	51	0	58	2	27	6	32	6	47	0	20	3	29	11	33	3
Norwich ...	30	7	47	6	55	6	25	2	30	2	48	6	18	2	28	0	32	7
Peterborough ...	30	6	49	4	56	6	25	8	30	11	48	3	18	5	28	7	32	2
Lincoln ...	31	4	49	5	57	3	26	7	30	3	49	8	19	2	27	6	31	9
Doncaster ...	31	1	49	1	57	4	24	9	30	0	49	3	18	4	27	2	31	8
Salisbury ...	30	4	48	11	56	6	26	3	31	1	50	2	19	0	29	0	33	2

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

MacDougall, J.—Rural Life in Canada: Its Trend and Tasks. (248 pp.) Toronto: The Westminster Co., 1913. $1.00. [63(71).]

Bangor, University College of North Wales, Department of Agriculture.—Bull. No. 5 (1914). Eradication of Bracken. (7 pp.) Bangor. [63.259.]

Waters, H. J.—The Essentials of Agriculture. (455 + XXXVI. pp.) Boston, U.S.A.: Ginn & Co., 1915. $1.25. [63(022).]

Radford, G.—The State as Farmer, or the Future of Agriculture in England. (148 pp.) London: Smith, Elder & Co., 1915. 2*s.* 6*d.* net. [63(42); 338.98.]

Wilson, A.—Changes in Soils brought about by Heating. (513–520 pp.) [Sci. Proc. Royal Dublin Soc., Vol. XIV. (N.S.) No. 38, May, 1915.] London: Williams & Norgate, 1915. 6*d.* [63.113.]

Haigh, W. D.—A Method for the Estimation of Hygroscopic Moisture in Soils. (529–534 pp.) [Sci. Proc. Royal Dublin Soc., Vol. XIV. (N.S.) No. 40, July, 1915.] London: Williams & Norgate, 1915. 6*d.* [63.113.]

Haviland, W. A.—The Effects of the European War on Agriculture. [Journal of the Farmers' Club, Nov., 1915.] (81–100 pp.) London: Farmers' Club. 6*d.* [63(42).]

Vermorel, V.—Agenda Agricole et Viticole (331 pp.), Villefranche Librairie du Progrès Agricole et Viticole, 1916. 1 fr. 50.

Field Crops—

University of Leeds and Yorkshire Council for Agricultural Education.—Bull. 97:—Report on Tests of Varieties of Wheat and Varieties of Winter Oats at Garforth, 1915. (12 pp.) Leeds, 1915. [63.311(02); 63.314.]

Switzerland, Secrétariat des paysans suisses.—Publications No. 52:—Rapport au Sujet de l'Encouragement de la Culture Indigène des Pommes de Terre par le Monopole suisse des Alcools. (57 pp.) Brougg, 1915. [63.512(04); 663.5.]

Live Stock—

North of Scotland Agricultural College.—Bull. 20:—Report on Feeding Experiment with Palm Kernel Cake, 1915. (10 pp.) Aberdeen, 1915. [63.604(*a*).]

(4296.) P. 16—9. 7,250. 2/16. J. T. & S., Ltd.

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

Vol. XXII. No. 12.

MARCH, 1916.

ACCUMULATED FERTILITY IN GRASS LAND IN CONSEQUENCE OF PHOSPHATIC MANURING:

Second Report on Experiments.

W. SOMERVILLE, M.A., D.SC.,

Sibthorpian Professor of Rural Economy in the University of Oxford.

THE issue of this *Journal* for September, 1914, contained a short account of some experiments conducted at Oxford with the view of ascertaining to what extent fertility is accumulated in grass land that has been treated with phosphates, such as basic slag. At that time only a single crop (oats) had been grown, but figures dealing in addition with three crops of mustard and a crop of wheat are now available, so that there are now much more ample data on which to base conclusions.

The problem may be briefly restated. A farmer dresses his grass land with a phosphatic manure, and he finds that, as a consequence, it can not only carry more stock but that each individual animal thrives better, making more bone and muscle, producing more fat, or giving more milk, as the case may be. By periodically weighing the animals the amount, for instance, of live-weight increase obtained per acre can be ascertained, and the result leaves no room for doubt that in the great majority of cases such treatment of grass land yields a satisfactory, often a very large, profit to the farmer.

Apart from the indirect effect on the stock the immediate and visible result is that clover, trefoil, kidney vetch, and leguminous plants generally, become more abundant and more vigorous, and as it is known that this class of plant fixes nitrogen from the air and stores it up in the soil in the form of humus, one would expect that such land would thereby be improved in fertility. Apart, however, from the special power of leguminous plants to add to fertility, the mere accumulation of vegetable matter by the growth of grasses must add to the productive capacity of

the soil. Such fertility, whether accumulated by leguminous or by non-leguminous vegetation, reacts upon the plants occupying the grass land, so that the effects of phosphates on the herbage are both direct and indirect.

So long as the pasture or meadow is left in grass it is a difficult matter to estimate the amount of this storage of fertility, but if the field were to be put under the plough the accumulation of fertility would cease; and not only so, but what has been stored up would be decomposed, and its plant food liberated. This aspect of the case is of special significance at the present time when the breaking up of pasture is being advocated in many quarters. It is possible, too, that after the war, economic and social considerations may result in an increase of the tillage area. In any event, it is a matter of some importance to ascertain to what extent the use of phosphates on grass land is likely to react on the cropping power of such land when converted to arable cultivation.

Method Employed in the Experiments.—The method employed in these experiments was to take supplies of soil, with the corresponding amount of turf, to a depth of about 9 in., and to place them in flower pots in which plants (oats, wheat, mustard) could be grown. The usual precautions as regards seed, number of plants per pot, watering, etc., were taken, and, on the whole, the work has proceeded with satisfactory freedom from disturbance. Soil from five centres was obtained, 10 pots being concerned with each centre. Five of the pots of each series were filled with soil that had been "treated" with basic slag, once or oftener, during previous years; while 5 pots were filled with soil from a part of the same field that had been left "untreated" with slag. The terms "treated" and "untreated" will be used in the following report in the sense just explained. Oats were grown in 1914, followed by two mustard crops in the same year. Wheat was sown in the autumn of 1914 and cut in July, 1915, after which another crop of mustard was taken.

Up to February, 1914, when the pot experiments were started, the fields at the five centres had been treated as follows:—

Denton Hill, Newhaven, Sussex: thin soil over chalk. Had been under very poor grass for about 8 years. Was dressed with basic slag at the rate of 7 cwt. per acre in March, 1911. The phenomenal drought of that year prevented any action during the first season, but in 1912 and 1913 the effects of the slag were very distinct. Grazed in 1911, cut for hay in 1912 and 1913.

Cockle Park, Northumberland: strong boulder clay, down to poor grass for many years. The "untreated" soil was taken from plot 6, while the "treated" was from plot 3. The latter

plot received 10 cwt. of basic slag per acre for 1897, 1906 and 1912, and the outlay has been repaid many times over.*

Stoke Talmage, Tetsworth, Oxon: heavy loam on Gault clay. Has been under grass for many years. The "treated" part of the field got 5 cwt. per acre of basic slag for 1910 and 1911. This dressing increased the yield of hay in 1910, 1911 and 1912 by 31 per cent.

Arncot, Bicester, Oxon: Oxford clay, rather wet, carrying inferior herbage. The "treated" portion of the field received 5 cwt. per acre of basic slag for 1909, 1910 and 1911. The field was grazed in 1910, 1912 and 1913, while a crop of hay was taken in 1909 and 1911. The slag increased the yield of hay by 50 per cent.

Lees Rest, Charlbury, Oxon: limestone brash on Great Oolite. Received 5 cwt. of basic slag per acre for 1910. This produced a striking effect on the herbage, which has been grazed each year.

Something went wrong with the oat plants (1914) in two of the pots filled with Arncot soil, so that the figures for this crop in the Arncot series have been rejected. The other 4 crops in this series, however, grew normally and have yielded reliable figures.

In the case of the oats and wheat 20 and 10 seeds respectively were sown in each pot, and, when well established, the plants were thinned down so that each pot had the same number (7 oats, 9 wheat). The mustard seed was supplied to each pot by measure.

While both "total weight" and "grain" were separately determined for the cereals, the figures for the former are alone dealt with in this report. The conclusions to which a consideration of the results leads would have been precisely the same had the "grain" figures been taken for discussion.

Experimental Error.—If experimental results are to be of any value they must be reliable. It is therefore desirable, in the first place, to test the fluctuations in yield that occur between sets of pots receiving exactly the same treatment. Such a test is afforded by comparing the yields of the first and second pots of each series. These pots were filled with "untreated" soil, and nothing was subsequently added but water. The total yield of the five crops† of the five series was 415·8 grammes for the first pot, and 419·0 grammes for the second pot, or as 100 is to 100·8 (see Table I.). This represents an experimental error of less than 1 per cent. Another similar test can be applied by

* See *Supplement to the Journal of the Board of Agriculture*, January, 1911.

† Four crops at Arncot, as explained above.

comparing the yields of the first and second pots of the "treated" soil of each series, as is done in the same Table. These pots were filled with "treated" soil and subsequently received nothing but water. The total yield of the five crops* of the five series was 525·5 grammes for the first pot, and 536·4 grammes for the second pot, or as 100 is to 102·1. Here the limit of error is just over 2 per cent. Apparently, therefore, when "treated" and "untreated" yields are compared, differences exceeding 2 per cent. may be considered as due to "treatment." In point of fact the limits of error are even narrower, because whereas this 2 per cent. variation applies to comparisons of 48 weighings, the comparison between "treated" and "untreated" results is never based on less than 98 weighings, and may be based on as many as 248. The detailed figures are set out in tabular form in Table I.

When the figures for only one centre are compared the limits of error are, of course, wider, because here we are comparing yields from only 5 crops grown successively in any one pot. When, however, "treated" and "untreated" results for a single centre are compared, we have comparisons, in one case, of 10 yields, and in another of 25, which, as above explained, reduces the limits of error.

TABLE I.

	Yields of the "untreated" soil.		Yields of the "treated" soil.	
	1st Pot. Grammes.	2nd Pot. Grammes.	1st Pot. Grammes.	2nd Pot. Grammes.
Denton Hill ..	79·5	81·3	94·7	96·9
	as 100	is to 102·3	as 100	is to 102·3
Cockle Park ..	73·0	73·4	125·9	122·7
	as 100	is to 100·5	as 100	is to 97·5
Stoke Talmage ..	93·7	102·4	93·4	107·5
	as 100	is to 109·3	as 100	is to 115·1
Arncot	78·1	80·1	125·7	123·7
	as 100	is to 102·6	as 100	is to 98·4
Lees Rest ..	91·5	81·8	85·8	85·6
	as 100	is to 89·4	as 100	is to 99·8
Total	415·8	419·0	525·5	536·4
	as 100	is to 100·8	as 100	is to 102·1

As will be seen, the limits of error are under 3 per cent. for Denton Hill, Cockle Park, and Arncot, while for Stoke Talmage and Lees Rest they run up to 15·1 and 10·6 per cent. respectively. In point of fact the detailed figures from these two centres are not of much interest, for the reason that there is neither cultural nor chemical evidence that fertility has been appreciably accumulated at either.

* Four crops Arncot.

What Amount of Fertility has been Stored up?—The experiments were so arranged as to furnish two answers to this question. The first two pots of each series were filled with "untreated" soil, while the sixth and seventh were filled with "treated" soil. In other respects the pots were all managed alike. The results are shown in Table II.

In each of the five series of soils there is a marked increase in the oats, but as regards the other four crops that follow there is a consistent increase only at Denton Hill, Cockle Park, and Arncot (see illustrations). On the aggregate of the five crops, the fertility stored up by the use of 7 cwt. per acre of basic slag at Denton Hill in 1911 has produced an increase of 19 per cent., the corresponding figures for 30 cwt. of slag at Cockle Park being 70 per cent. and for 15 cwt. of slag at Arncot (4 crops) 58 per cent. The total yield of the five "untreated" soils is 834·8 grammes, while that of the five "treated" soils is 1061·9 grammes, the increase thus averaging 27 per cent.

By comparing the last 3 pots of the "untreated" soil in each series with the last 3 pots of the "treated" soil, we get a further answer to the question. Each of these 3 pots got direct manuring, but as it was precisely the same in each set of pots it may for the present be disregarded and attention confined to the question of residual fertility. The detailed figures are set out in Table III.

Where manure has been used directly, as it was in all these pots, the fertility stored up in the grass land has not had quite so full an opportunity of producing its effects, with the result that, on the whole, the percentage increase in the "treated" plots, as shown in Table III., is rather less than where no manure was directly applied to the pots (Table II.). In the aggregate the yield of these five "untreated" soils is 1329·0 grammes, while that of the five "treated" soils is 1612·6 grammes, or an average increase of 21 per cent.

As was to be expected, the storage of fertility has been greatest in the case of the pasture which has been subjected to treatment with basic slag over the longest period, though the quantity of slag used has no doubt also had a determining effect. The soil from Cockle Park, which has had 10 cwt. of basic slag per acre for 1897, 1906 and 1912—30 cwt. in all in 17 years, up to the spring of 1914 when the samples were taken—has given increases of 50 and 70 per cent. as compared with "untreated" soil. Arncot, getting 5 cwt. per acre of basic slag in 1909, 1910 and 1911—15 cwt. in all in 4 years up to the spring of 1914—has produced increases of 45 and 58 per cent. Denton Hill, which got a single dressing of 7 cwt. per acre of basic

slag for 1911, has given increases of 8 and 19 per cent. Stoke Talmage and Lees Rest, getting respectively 10 and 5 cwt. per acre of slag, have shown but little, if any, accumulation of residual fertility, a result perhaps due in part to the unsuitability of these soils for the growth of mustard. If the cereals alone are considered there is marked evidence of the accumulation of fertility in seven of the eight tests applied to these soils (see Tables II. and III.).

To What is the Accumulation of Fertility due?—In considering this subject it naturally occurs to one to inquire whether the unused residue of the slag applied to the grass may not have had a large effect on the oats, mustard, and wheat. In the "untreated" series of pots for each centre, one pot, the third in each case, received 1 gramme of slag in 1914 before sowing the oats. Although small in actual amount this is really a relatively large dose, and is probably equal to about 15 cwt. per acre.* The effect of this dressing of slag was apparent in the yields of all the soils, with the exception of Stoke Talmage, and the aggregate produce of the five crops of the five series of soils was increased by 12 per cent.

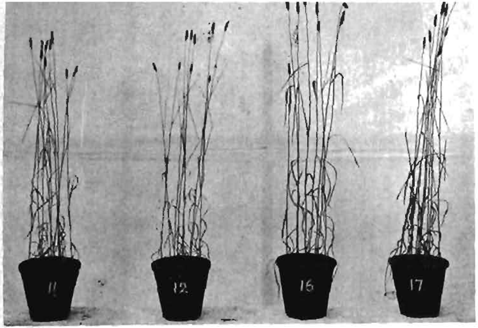
The third pot of the "treated" soil for each series also directly received a gramme of slag, which produced some effect in all cases, the average increase for the five crops of the five series being, however, only 5 per cent. The fact that the slag used in the pots produced less than half the increase when used on the "treated," as compared with the "untreated" soil, indicates that the slag used on the grass in previous years has left some residues that have reacted on the oats, etc., but these residues are very small.

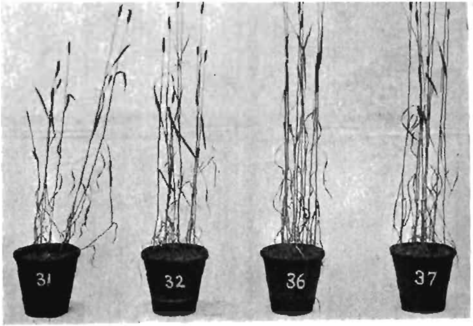
Chemical analysis (see Table IV.) has been able to detect these residues in the case of three of the soils (Denton Hill, Cockle Park and Arncot), the increase of phosphoric acid in the "treated" soils of these centres being presumably due to slag residues.

When the yields of the two pots of "treated" soil are compared with the two pots of "untreated" soil (nothing being added to the pots in either case), the increase is found to be 27 per cent., and it may safely be assumed that, of this increase, only a small proportion is due to the effects of the residues of slag. Something else than slag residues has clearly been operative, and it seems safe to assume that this has been the humus,

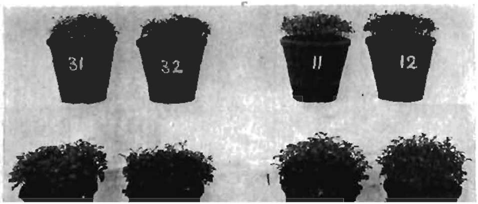
* The figure is arrived at on the assumption that the effective soil on an acre weighs three million pounds. The pots contained, on the average, rather less than 4 lb. of dry soil. One gramme of slag added to 4 lb. of soil is equal to 750,000 grammes (= 15 cwt.) of slag for the soil of an acre.

A





C



A—Wheat of 1915, grown in Cockle Park soil. *Pots* 11 and 12 contained soil from the "untreated" part of Tree Field, while pots 16 and 17 got soil from a part of *the field*, *which* during 17 years had received an aggregate of $1\frac{1}{2}$ tons of basic slag per acre. A crop of oats and 2 crops *of mustard* were taken from these pots in 1914.

B – Wheat of 1915, grown in soil from Arncot, *Oxon*. Pots 31 and 32 contained soil from the "untreated" part of the field, while pots 36 and 37 got soil from a part *of the* field which received 5 cwt. of basic slag per acre in each of the years 1909, 1910, and 1911. A crop of oats and 2 *crops* of mustard were taken from these pots in 1914.

C. –Second crop of mustard in 1914. *Previously in the same* year a crop of oats and a crop of mustard had been taken from these pots. Pots 11 and 12 contained *soil from "untreated"* part of Tree Field, Cockle Park, while pots 16 and 17 got soil from

including the nitrogen stored up in the grass land before it was broken up.

That the nitrogen collected from the atmosphere and stored up in the humus is largely accountable for the increased production in the pots of "treated" soil, is shown by the results in pots to which ½ gramme (7 cwt. per acre) of rape meal was added for the oats of 1914. In the "untreated" series of pots the rape meal, when used alone, increased the produce of the five crops of each series, except that of Stoke Talmage; the gross yield of the five crops of the five series, where no rape meal was used, being 418·6 grammes, as compared with 438·2 grammes where it was used, an increase, namely, of 5 per cent. For the "treated" series of pots the corresponding figures are 531·4 grammes without rape meal, and 521·9 grammes with it, the rape meal in this case having done no good. The fact that the nitrogen of the rape meal failed to act in the "treated" series of soils would appear to be due to the presence of abundant nitrogen stored up by the Leguminosæ, which were stimulated by the basic slag applied to the land when in grass.

The figures also provide a standard for measuring the amount of such accumulated fertility, for whereas the crop-increase on "treated" but directly unmanured soil, as compared with similar "untreated" soil, averaged 27 per cent., it was only 5 per cent. under the influence of the rape meal. Apparently, therefore, the nitrogen stored up in an acre, as the result of slagging the pastures, is greater in amount than that present in 7 cwt. of rape meal.

The increase in nitrogen in the soil is distinctly shown by the chemical analysis made by Mr. C. G. T. Morison, Lecturer in Agricultural Chemistry, of the soil samples taken in the spring of 1914, when the pot experiments were started. The results are set out in Table IV., and show that the total nitrogen has been largely increased at Cockle Park, and to a less extent at Denton Hill and Arncot. At Stoke Talmage and Lees Rest no accumulation of nitrogen was detected by chemical analyses. These results are in general agreement with those obtained by the growth in the pots of wheat, oats and mustard, that is to say, the three series (Denton Hill, Cockle Park and Arncot), showing the large crop increases, are also those showing the increases of nitrogen, while the two that show no increase in nitrogen (Stoke Talmage and Lees Rest) are also those showing practically no increase in crop produce.

Summary and Conclusions.—(*1*) When basic slag is used on grass land the increase of herbage, or of meat or milk, does not represent the whole of the benefits. Concurrently with such increase

TABLES II., III., AND IV.

TABLE II.

	Denton Hill.		Cockle Park.		Stoke Talmage.		Arncot.		Lees Rest.	
	2 Pots of "Untreated" Soil.	2 Pots of "Treated" Soil.	2 Pots of "Untreated" Soil.	2 Pots of "Treated" Soil.	2 Pots of "Untreated" Soil.	2 Pots of "Treated" Soil.	2 Pots of "Untreated" Soil.	2 Pots of "Treated" Soil.	2 Pots of "Untreated" Soil.	2 Pots of "Treated" Soil.
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
Oats, 1914..	17·0	38·0	15·0	38·0	34·0	39·0	*	*	16·0	21·0
2 Mustard Crops, 1914	68·0	71·8	77·2	127·3	73·5	74·0	95·8	162·2	88·7	79·2
Wheat, 1915	56·0	60·0	29·0	42·5	55·0	60·0	34·0	52·5	44·0	48·0
Mustard ,, ...	19·8	21·8	25·2	40·8	33·6	27·9	28·4	34·7	24·6	23·2
Total	160·8 as 100	191·6 is to 119	46·4 as 100	248·6 is to 170	196·1 as 100	200·9 is to 102	158·2 as 100	249.4 is to 158	173.3 as 100	171.4 is to 99

TABLE III.

	Denton Hill.		Cockle Park.		Stoke Talmage.		Arncot.		Lees Rest.	
	3 Pots of "Untreated" Soil.	3 Pots of "Treated" Soil.	3 Pots of "Untreated" Soil.	3 Pots of "Treated" Soil.	3 Pots of "Untreated" Soil.	3 Pots of "Treated" Soil.	3 Pots of "Untreated" Soil.	3 Pots of "Treated" Soil.	3 Pots of "Untreated" Soil.	3 Pots of "Treated" Soil.
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
Oats, 1914..	38·0	60·0	24·0	56·0	17·0	55·0	*	*	34·0	37·0
2 Mustard Crops, 1914	101·7	112·7	121·0	174·8	111·7	115·8	145·6	228·5	125·3	132·2
Wheat 1915	115·5	101·0	41·5	57·5	77·5	88·5	55·5	92·0	88·0	81·5
Mustard ,, ...	31·8	36·2	46·7	61·9	37·7	38·8	50·1	44·2	36·4	39·0
Total	287·0 as 100	309·9 is to 108.	233·2 as 100	350·2 is to 150	273·0 as 100.	298·1 is to 109	251·2 as 100	364·7 is to 145	283·7 as 100	289·7 is to 102

TABLE IV.

	Denton Hill.		Cockle Park.		Stoke Talmage.		Arncot.		Lees Rest.	
	"Untreated." *Per cent.*	"Treated." *Per cent.*	"Untreated." *Per cent.*	"Treated." *Per cent.*	"Untreated." *Per cent.*	"Treated." *Per cent.*	"Untreated." *Per cent.*	"Treated." *Per cent.*	"Untreated." *Per cent.*	"Treated." *Per cent.*
Total Nitrogen	·295	·317	·136	·205	·303	·278	·503	·511	·323	·309
Ammoniacal and Nitric Nitrogen ..	·0003	·0003	·0001	·0002	·0004	·0004	·0001	·0001	·0005	·0004
Total Phosphoric Acid	·155	·177	·049	·063	·145	·109	·120	·124	·183	·174
Citric Soluble Phosphoric Acid	·001	·002	·005	·006	·027	·025	·004	·003	·002	·003

* Figures for the oat crop at this Station rejected, as previously explained.

there is improvement in the fertility of the soil, and probably such improvement is in direct proportion to the increase of herbage, meat or milk.

(2) The extent of the accumulation of fertility depends on the amount of slag used, on the period of time during which it acts, and on the way in which the land responds to it. In the Cockle Park series the oats, wheat, and mustard grown in 1914 and 1915 were improved 70 per cent. as the result of the libera tion of this fertility, and the fifth crop (mustard, 1915) shows practically no sign of the beginning of the process of exhaustion. On other soils, which had not been so liberally, or so long treated, the storage of fertility was less in amount (Denton Hill and Arncot), though here, also, five crops had not exhausted it. In the case of soils from two centres (Stoke Talmage and Lees Rest) pot culture showed little, if any, storage of fertility. This negative result may be due partly to the unsuitability of these soils for pot culture, and partly to their unsuitability for the growth of mustard, the failure to disclose accumulated fertility resting with this plant rather than with the two cereals. The fact, however, that chemical analysis failed to reveal any increase of nitrogen in these two soils, seems to indicate that local conditions affect the accumulation of fertility. The average increase of fertility, as disclosed by the growth of five crops in the five soils employed, was 27 per cent.

(3) The fertility that is accumulated seems to be largely due to nitrogen stored up by leguminous plants, though increase in non-leguminous humus is probably not without influence. Residues of slag appear also to play some small part in the result.

(4) In the event of the extension of the tillage area the individual and the nation will both benefit from the enterprise of farmers who have, during past years, freely used basic slag on their grass land. While these experiments are confined to the effects of basic slag, there is no reason to doubt that similar results would have been obtained with other effective forms of phosphate.

(5) While the returns from the use of phosphates on grass land are chiefly to be looked for in the form of increase in the quantity and quality of the hay crop, or in the increased production of meat or milk, or in the improved well-being of farm stock generally, the residual fertility must not be overlooked. Even if it could do no more than accomplish a 10 per cent. increase in two tillage crops this would be sufficient in many cases to repay the original cost of the treatment.

THE GROWING OF SUGAR BEET.

In view of the present state of the sugar supply it is of great importance that efforts should be made to establish the sugar beet industry in this country, and that the fullest possible use should be made of such facilities as already exist for the manufacture of sugar from beet. Sugar beet has been grown experimentally in many parts of Great Britain for several years, but it is only since 1912 that growers have been able to dispose of their crops for the manufacture of sugar. This development is due to the enterprise of the Anglo-Netherland Sugar Corporation, Limited, who erected a factory at Cantley, in Norfolk. In the 4 years during which the factory has been in operation the average quantity of sugar-beets "worked" has been about 20,000 tons per annum, or, approximately, one-fourth of the quantity necessary to keep the factory running at full pressure. The factory "campaign" is a short one at best, as the beet must be "worked" as soon as possible after the crop is lifted, in order to prevent waste. It will thus be apparent that the industry has not yet reached the stage of development at which satisfactory results can be expected, and the difficulties which the Corporation have had to face are largely attributable to failure to obtain adequate supplies of raw material. If the industry is to secure a permanent footing, the co-operation of farmers ready to provide sufficient supplies of beet is essential.

In the year which has just closed the factory dealt with the produce of about 2,150 acres. The crops, on the whole, were satisfactory, yielding, on the average, just over 9 tons of washed roots per acre. The sugar content of the beet also was very good, namely, 17·36 per cent., a figure comparable with that obtained under the most favourable conditions on the Continent. Growers were paid for their crops in accordance with a sliding scale of prices based on the average selling price of sugar secured by the Corporation, viz.:—

Average Sale Price of Sugar per cwt. *s. d.*	*Price for Sugar Beet per ton.* *s. d.*	*Average Sale Price of Sugar per cwt.* *s. d.*	*Price for Sugar Beet per ton.* *s. d.*
19 0 (or under)	25 0	24 0 ..	30 0
19 6 ..	25 6	24 6 ..	30 6
20 0 ..	26 0	25 0 ..	31 0
20 6 ..	26 6	25 6 ..	31 6
21 0 ..	27 0	26 0 ..	32 0
21 6 ..	27 6	26 6 ..	32 6
22 0 ..	28 0	27 0 ..	33 0
22 6 ..	28 6	27 6 ..	33 6
23 0 ..	29 0	28 0 ..	34 0.
23 6 ..	29 6		

On this basis farmers received 30*s*. 8*d*. per ton f.o.r. for washed roots, representing an average return per acre of about £14.

Cost of Cultivation.—Figures relating to the cost of growing the crop in Norfolk and Suffolk in 1914 were published in this *Journal* for February, 1915, in an article contributed by Messrs. Orwin and Orr, of the Research Institute in Agricultural Economics, Oxford. Labour difficulties were somewhat more acute in 1915, but the actual cost of cultivation does not appear to have been materially greater than in the previous year. One grower unable to obtain man labour for lifting resorted to women. He reports that "during two of the wettest months I have ever known—November and December—18 women at piece-work lifted and topped 50 acres of sugar beet at about the same cost as it would have been had men undertaken the work."

Another grower produced, at his first attempt, 14 tons of washed roots per acre, at an estimated cost of from £11 to £12 an acre. He reports, "I am so satisfied with the result that I am going to grow 50 acres this season and, had it not been for the war, would have doubled this acreage." He states, further, that he found the lifting easier than he anticipated, "women, by using a fork to loosen the soil, lifted the beets quite easily and at moderate cost."

The following figures supplied by Mr. B. S. Sillem show the average cost of cultivation per acre on the Cantley Manor Estate, in 1915, the soil being a uniform free-working loam:—

	£	s.	d.
Two ploughings		16	0
Subsoiling		8	0
Farmyard manure, 10 tons at 3*s*. 6*d*. per ton	1	15	0
Harrowing and rolling before sowing ..		3	0
Rolling after sowing		1	0
Seed—15 lb. per acre		6	3
Drilling		1	9
Artificial manures	2	0	0
Chopping out and singling	1	5	0
Horse-hoeing, 3 times		6	0
Lifting and topping	1	5	0
Carting	1	4	0
Rent, rates and taxes	1	5	0
Cost per acre ..	£10	16	0

Altogether Mr. Sillem grew 295 acres of beet in 14 different fields, the total yield obtained being 3,761½ tons of washed roots, which works out at the rate of 12¾ tons per acre, worth £19 11*s*., exclusive of the value of the tops. The highest yield of washed beet—15 tons—was grown on a field of 29½ acres. The lowest yield of any was 10 tons of washed beet per acre. The average amount of dirt deducted was 14 per cent.

Some inconvenience was caused at singling time, owing to a strike of workmen, and about 68 acres were "bunched" by machinery.

Incidentally it may be mentioned that the heaviest crop of beet followed a crop of wheat which yielded 6½ qr. per acre. The wheat was manured with 2 cwt. of sulphate of ammonia per acre in autumn and 1 cwt. per acre of nitrate of soda in the following spring.

It is not claimed that the figures assigned to the various tillage operations are more than approximately correct, or that they are necessarily typical of conditions generally in the Eastern Counties, but it may be mentioned that the ordinary cost of cultivation on light land in the Eastern Counties was usually estimated before the war at from £8 10*s.* to £10 15*s.* per acre, and on loamy soils in other parts of England at from £10 to £12 per acre.

Indirect Advantages.—Against the cost of production must be set, in addition to the price obtained for the crop, certain indirect advantages accruing from the cultivation of sugar beet. There is almost general agreement that the extra treatment in the form of subsoiling, cleaning and manuring benefits the subsequent crops, though to what extent has not, so far, been accurately determined. Another item that must be considered is the value of the leaves and crowns left on the land after the crop has been removed. One grower of 50 acres reports that the residue referred to has kept 300 breeding ewes for 3 months, thus replacing about 25 acres of turnips, which at £5 per acre has meant a saving of £125. Cases are common where feeding on the tops has been let at 20*s.* an acre, and this figure is much below that usually assigned to the residue by continental growers.*

The tops are rich in potash and, when ploughed under, their manurial value is considerable.

By-products.—Of the factory by-products the chief is the dried slices or pulp, the residue after the extraction of the greater part of the sugar from the beet. This usually represents about 10 per cent. of the weight of beet manufactured: it is easily transported and it constitutes a useful feeding-stuff. During the past season dried pulp (protos) has been selling at £8 and upwards per ton. Dried pulp prepared by the process in use at Cantley and containing 8·6 per cent. of moisture, if soaked in 9 parts by weight of water would contain as much dry matter as man-

* The feeding and manurial values of sugar beet crowns and leaves, *Journal*, November, 1915.

golds of good quality, and from the standpoint of feeding units would be rather more valuable in the proportion of 17·5 per cent. in the soaked pulp to 14 per cent. in Golden Tankard Mangolds.

At £8 per ton for dried pulp the soaked pulp costs 16*s.* per ton, and if the actual values of the two foods are represented by the ratio 17·5:14, then with soaked pulp at 16*s.*, mangolds would be worth 12*s.* 9*d.* per ton. It would seem, therefore, that the stockfeeder who values his mangolds at 12*s.* 9*d.* per ton, would be able to provide a substitute if in place of putting all his root land under mangolds he devoted a share to sugar beet and bought in dried pulp at £8 per ton.

Another by-product of special value at the present time is molasses, the yield of which is usually at the rate of about 2 per cent. of the weight of beets worked.

General.—Reports received by the Board furnish evidence that growers, as a whole, are well pleased with the results of last year's operations. Owing to the high price of store cattle in the autumn of 1915, coupled with the increased cost of feeding-stuffs, it is to be feared that fattening cattle have left little, if any, profit to the feeder. Apart from national considerations, it is becoming more and more clear that the introduction of sugar beet would be a distinct gain to British agriculture, inasmuch as it would provide an alternative to cattle- and sheep-feeding in years when stock are unprofitable. It is not suggested, of course, that anyone should entirely substitute beet for mangolds and swedes, but if a farmer had a certain area under each crop he would be less dependent on fluctuations in the value of live stock. The greater the number of saleable crops produced the safer the system of farming. At the present time labour difficulties prevent farmers from growing much sugar beet, and to attempt to grow more than they can deal with satisfactorily is, of course, inadvisable.

With its present equipment the Cantley factory could easily handle about 60,000 tons of washed beet in a season, that is to say, the produce of from 6,000 to 7,000 acres, assuming a yield of 9 tons per acre (the average crop produced last year). This acreage would represent only about 1/40 of the total area annually under roots and bare fallow in the counties of Norfolk and Suffolk alone. In the past, however, beet has also been grown for the Cantley factory in Lincolnshire, Cambridgeshire, Huntingdonshire, Hertfordshire and Essex. If farmers within reasonable distance of Cantley would grow even a very small acreage of sugar beet, the needs of the

factory would be adequately met and the foundations of a successful industry would be securely laid. With the conclusion of the war and an increase in the supply of sugar, a fall in the price of beet may be anticipated; but in the meantime farmers would gain an experience of the crop which should enable them to reduce the cost of growing and to secure a somewhat heavier and steadier yield.

The prices offered for next crop are based on the same sliding scale as that in vogue last year, as given above.

Advice on the cultivation of the crop, the purchase of seed, lifting and cleaning of the roots, etc., will be supplied to growers on application to the Manager, Beet Sugar Factory, Cantley, Norfolk.

It may be pointed out that sugar beet has a considerable value for feeding purposes, apart from any question of the production of sugar. In cases, therefore, where trial crops are grown to ascertain the capabilities of the soil and locality for growing sugar beet, the crops can be turned to useful account, even where it is not possible to dispose of them for sugar manufacture. Analyses show that, on the average, sugar beet contains from 20 to 25 per cent. of dry matter as compared with 9 to 13 per cent. in mangolds. Although the relative feeding values of sugar beets and mangolds have not been definitely determined in this country, the results of Danish and American experiments show that, for feeding purposes, 4 lb. of beet are approximately equal to 8 lb. of mangolds or 1 lb. of cereal meals in mixed rations. Farmers who are unable to grow beet in sufficient quantity to make a contract with the Anglo-Netherland Sugar Corporation, but would like to grow a few rows among their mangolds as an experiment, may obtain ¾ lb. of seed, post free, from the offices of the Corporation, Cantley, Norfolk, for a postal order for *1s.* The seed should be dibbled in, 2–3 seeds together, in holes 8 in. apart when sowing mangolds.

Further information on the subject of sugar beet growing as practised both in this country and on the Continent is contained in an article entitled "Notes on the Sugar Beet Crop," which appeared in this *Journal* for February, 1915.

FARM VALUATIONS FOR BOOK-KEEPING PURPOSES.

JAMES WYLLIE. B.SC., N.D.A.,

Lecturer on Book-Keeping, West of Scotland Agricultural College.

IT must be admitted that the great majority of farmers are slow to realise the advantages to be derived from a proper system of book-keeping on the farm, and they are, perhaps, too prone to over-estimate the difficulties connected with even the simplest system which can be laid before them. The recent change which has been made in the basis for assessing farm income tax should, however, lead many farmers to consider seriously whether it would not be to their advantage to adopt some method of book-keeping which would enable them to claim assessment on their actual profits instead of on their full yearly rental. The object of this article is to indicate how the farmer should proceed to lay a sound and necessary foundation upon which he may construct whichever system of accounts he considers most suitable for his particular circumstances.

The first step which a farmer has to take when he decides to keep systematic accounts is to make a complete inventory and valuation of all the various classes of stock, both live and dead, upon the farm. He must also make out an accurate statement of all debts payable and debts receivable, and ascertain how much cash he has in hand and in the bank. In other words, he must draw up a Balance Sheet showing his total assets and total liabilities and thence find how much *Capital* he has invested in the farm.

This *Balance Sheet* will have to be revised periodically, usually annually, upon the farm. From it the farmer can judge whether his capital in the farm is increasing or decreasing, but it does not show what profit or loss has accrued from a year's working of the farm. It cannot be too strongly emphasised that a reliable balance sheet is the bed rock of all reliable book-keeping, and the foundation of a reliable balance sheet lies in the making of a fair, just and reliable valuation of stock. This applies particularly to farm accounts, since market prices for farm produce fluctuate very considerably from year to year, and even from month to month. Two aspects of the annual farm valuation or stock-taking require careful consideration, viz.: (A) The Date at which the Valuation should be made, and (B) the Principles upon which it should be made.

(A) **The Date of Valuation.**—Generally, the most convenient date will be at one of the usual terms of entry to farms, viz.: Lady Day (25th March) or Michaelmas (29th September) in England, and Whitsunday (28th May) or Martinmas (28th November) in Scotland. It will be an advantage if the farmer can square up his accounts in the usual way in the event of his leaving one farm for another, but no hard and fast rules can be laid down, and much will depend upon the particular system of farming followed.

It will be readily admitted that the best and most desirable date will be that at which there is the *minimum* of valuation to effect, and it should also be borne in mind that it is much easier to value some kinds of stock than others. No matter what methods are followed in determining values, the work will be easier and the results more reliable if the valuation is made when the amount of marketable stock on the farm is at a minimum. At what period of the year, then, is this date most likely to occur? How far does each of the common dates of entry satisfy this condition?

Taking a broad, general view there is one fundamental objection to Michaelmas or Martinmas as a date for the farm stock-taking, viz., that it falls practically in the middle of the farmer's year. Consider the case of oats sown in the spring of 1915. It is perfectly clear that, in the great majority of cases, it would require *two* years' accounts to show the actual profit (or loss) on this crop, for a great part would still be in stock at either of these dates, and only a paper profit (or loss) could be shown in the books for 1914-15. And so for other crops. Now it is highly desirable that the book-keeping year should, as far as possible, correspond with the farming year, which commences in the spring rather than in the autumn. Lady Day or Whitsunday is certainly much nearer the beginning of the farming year, and on that account should be generally preferred to Michaelmas or Martinmas. It is remarkable that many valuers prefer to take stock at Michaelmas or Martinmas on the ground that there *is* more stock to value then than in the spring, ignoring the fact that a valuation, for book-keeping purposes, is at the best to be looked upon as a necessary evil, which should be avoided as far as possible.

The argument in favour of a spring rather than an autumn valuation is strengthened by considering the case of crops. At Michaelmas or Martinmas the crops will be very largely harvested, and only a small part of the tillages for next season's crops will have been done. But only a small proportion of the

crop will have been disposed of, either by sale or by consumption on the holding, and the extent of the necessary valuation will be very great. In other words, either of these dates falls between the harvesting and the realisation of the crop. With a spring valuation, on the other hand, the greater part of the previous season's crop will have been realised, and only the costs of the tillages, etc., for the current season's crop will fall to be determined. As will be shown later, it is much easier to value tillages than crops in stacks or in pits, the amount of valuing to do will be considerably less, and the book-keeping year will correspond more closely with the cropping year.

As regards live stock and other classes of dead stock, it would appear to be largely immaterial at what date these are valued, although here also the balance is in favour of a spring valuation, since the stock-breeder's year, as well as in many cases the stock-feeder's, generally commences in the spring rather than in the autumn.

Given a free choice, however, it cannot be said that either Lady Day or Whitsunday is the best date for valuation on the average farm. The former is perhaps rather early, the latter rather late. In any case, in view of what has been said above, it would be desirable to delay stock-taking until at least very little of the previous year's crop remains to be disposed of.

It may, therefore, be generally recommended that on the average cropping, stock-feeding, dairy or mixed farm the valuation for book-keeping purposes should be made at the most convenient date between Lady Day and Whitsunday. In regard to the *hill sheep farm*, however, the best date would fall between about the end of August and the end of September, that is, after the season's crop of lambs, etc., has been sold off, and the breeding stock made up for the next season. In this case, the farming year commences in the autumn, and the valuation should be made accordingly. The deciding factor is the same as for the average lowland farm, viz., that at this time there is a minimum of stock to value, the valuation is easier and the result more reliable.

(B) **The Principles of Valuation.**— Two leading principles in the valuation of stock of all kinds may first of all be enunciated, viz.: (1) The values fixed must on no account be too high, that is, it should be possible at any time to realise the values put upon the stock. The farm valuer too often ignores or forgets this principle. (2) Uncompleted articles of all kinds, *e.g.*, growing crops, young stock, etc., should be valued at cost of production up to date. Further, where it is not possible to fix the values

automatically, that is from cost-accounts, the valuation should be done by an independent party and preferably by the same party from year to year. Bearing these general principles in mind, the various classes of stock may be discussed in some detail.

(*a*) CROPS.—This section should give little trouble to the qualified valuer. Generally, the basis of valuation should be *cost of production* up to date. With a spring valuation, the value would include the cost of the various tillages, seed, manure, etc., whereas with an autumn one it would embrace summer cultivations and perhaps harvesting as well, along with a proportion of the yearly rent, rates and taxes. Hence, the spring valuation entails much less labour, so far as growing crops are concerned. Where cost accounts are kept, the values would be automatically determined in the respective crop accounts, but in other cases (the great majority), and in any case for the first year or so, the cost of production would have to be estimated. A list of the cost of the various operations—ploughing, harrowing, drilling, etc.—could be drawn up, and these would not vary much on the same farm from one year to another. In fact, it would be fairly accurate to keep the estimated cost per acre for each crop at approximately the same figure from year to year, although there would of course be differences in the number of acres of the various crops, which would affect the total value.

The chief difficulty as regards crops lies in valuing those in stacks, pits, etc., and it should be noted that this difficulty scarcely arises where the valuation is made at a suitable date in the spring. Here it will be found that the valuer very generally ignores the cost basis and fixes the values according to current market prices or, it may be, on what is known as feeding or consuming value. So far as the consuming value basis is concerned, little objection can be taken from a purely book-keeping point of view, since the values are not likely to vary much from year to year. Not so with the market value basis, however. A farmer may have about 100 tons of potatoes in pits at, say, Martinmas, and the current market price may be £3 per ton; but neither the farmer nor the valuer can foretell the price at which the potatoes will actually be sold, or indeed whether they will be sold at all. The result must be that the profit (or loss) shown after such a valuation has been made is a purely fictitious or paper one. It cannot be gainsaid that by far the soundest method of dealing with the potato or other crop under such circumstances is to carry it forward at cost. *No real profit can possibly accrue from produce which is still in stock.*

There is a further difficulty in dealing with harvested crops, viz., the difficulty of estimating the *quantity*. In the example taken above, who can guarantee that there are 100 tons of potatoes, neither more nor less? It is a case of raising difficulties and opportunities for errors where none need exist. How much easier it would be to take so many acres and value them at cost per acre.

(*b*) LIVE STOCK.—With this class of stock also the valuer would be well advised to base the valuations generally upon cost price, but there are certain important exceptions which are discussed below. It would appear that old methods—often utterly unsound—are continued in practice through a misunderstanding of the real object of making a valuation for book-keeping purposes. Broadly speaking, the fundamental object is, *not* to show what the farmer is worth, nor yet to show what capital is invested in the farm, but to assist in the determination of the actual profit or loss from the year's actual financial operations. It is this object which the valuer must keep primarily in view: it is only under special circumstances that the other objects mentioned become of first importance.

Live stock may conveniently be divided into two classes, according to whether they are kept for the specific object of *direct* profit-making. Horses, for example, are mainly kept for the labour they perform, cows for milk (and calves), ewes for lambs (and wool) and sows for pigs. In brief, horses and breeding stock generally may be looked upon as machinery for turning out other products from which the profits are derived. On the other hand, feeding stock (cattle, sheep and pigs) are expected to yield a direct profit; they produce nothing else (except wool) from which a profit may be obtained. Hence, the valuer should keep this distinction in mind in deciding upon the method of valuation which he will apply to different classes of live stock.

Cattle.—Take first the case of *milk cows*. The question at once arises: are these to be valued at cost price, at market value or at some figure intermediate between cost and market price? Recent experience on the dairy farm provides an excellent illustration of the results which would obtain from the different methods.

Consider, for example, a milk-selling farm on which there is a regular herd of 40 cows (*i.e.*, each cow will remain in the herd for from 3 to 6 years, according to quality, etc.). At Lady Day, 1914, the herd was valued, on a market basis, at £18 per head, while at Lady Day, 1915, the corresponding figure rose to £22

per head. In effect, it is clear that this would have resulted in a "profit" of £160, apart altogether from considerations of milk-yield, milk prices, cost of feeding, etc. Now, in point of fact, the year 1914-15 was in many cases a lean year for such farmers, on account of existing milk contracts at pre-war prices, high prices of feeding-stuffs, dear labour, and so forth, and, but for the increased valuation, the year would very probably have shown a profit below, instead of above, the average. The above £160 is a purely fictitious profit; it does not represent real profit from actual transactions, since most of the cows will remain on the farm for several years longer; and the balance in the farmer's bank account would not bear out the increased profit shown in his books. No qualified accountant could possibly approve such a method; it is against one of the fundamental principles of ordinary business valuations.

As already indicated, such a method is largely followed because the valuer fails to realise that the primary object of keeping an account for cows is to discover the profit (or loss) from milk-production and *not* to show what profit *might* be made *if* all the cows were to be sold off. We need have no hesitation, therefore, in discarding this method of valuation with reference to milk cows.

Coming now to the cost basis, an initial difficulty has at once to be dealt with. What is the net cost of production of, say, a home-bred 5-year-old cow, which has been 2 years in the herd? On the one hand, we have the cost of feeding, labour, etc., but on the other we must put the value of the milk and calves which she has produced. Further consideration would at once show that the cost basis is *not* applicable to such stock, for the reason that in a high-class herd the values would come out lower than in a poor herd. We have, therefore, to fall back upon a third method, which takes account both of cost and of market value. The principle can best be explained by taking a specific case.

An average or "standard" Ayrshire cow may cost, say, £14 to bring into the herd, that is, up to the date of her first calf at about three years old. Thereafter, she may be expected to increase both in market value and in intrinsic value as a milk-producer by from £2 to £3 per annum for the next two or three years and then decrease in value by from £3 to £4 per annum for the following three or four years, after which she will be disposed of. Taking the successive valuations to be £14, £16, £18, £15, £12 and £9, this would give an average of £14, and since there would be approximately the same number of cows of the various ages in the herd "the standard value," as it may be called,

may be fixed at £14 per head. This principle can, of course, be applied to any herd and the standard value thus obtained. It should be observed, however, that this standard value should be so low that the average market value of the cows in the herd is not likely to fall below it, unless under highly abnormal conditions.

We thus fix upon the "standard value basis" for the valuation of dairy cows in the regular herd. In practice, each cow may be valued separately as above indicated, but in large herds accurate enough results will be obtained by valuing the herd at so much per head. It is clear that the total valuation will depend upon (1) the numbers of the various ages in the herd (in some years more old cows may be sold off and more heifers brought in than in others), and (2) whether the intrinsic and therefore the average market value of the standard cow in the herd is being raised (where milk records are kept the standard value could be gradually raised, not only because of higher average milk yield, but also because of higher average market value).

To revert now to the case given above. The standard value at Lady Day, 1914, may have been fixed at £16 per head, and the same figure may have been taken at Lady Day, 1915. The accounts would then show the actual profit (or loss) from the year's monetary transactions (in milk, calves, etc.); the farmer's books would corroborate the evidence of his bank-book and agree with his own general impressions as to the year's financial results. In effect, the dairy herd should be looked upon as a factory for turning out milk (with calves as a by-product), the profit from which depends upon the price of milk, cost of feeding, labour, rent, etc., and only to a very limited extent upon the market price of the cows themselves.

The valuation of *purchased cows* still remains to be considered, and may, at first sight, present considerable difficulty. Taking the extreme case of the so-called "flying stock" where the cows are bought in, milked for about a year and then sold off just as they stand, three points may be noted: (1) There will be considerable depreciation in market value between buying and selling—from £5 to £10 per head; (2) the profit from the herd as a whole depends to a greater extent upon the market price of the cows than in the case of a regular herd; but (3) the main profit still comes from the milk produced—the cows in this case being merely machinery which wears away quickly and has to be replaced very frequently. Even in such a herd, however, the average value of the cows at, say, Lady Day, will not vary very much from year to year, since the cows will be purchased at

different dates throughout the year and the valuation may again be quite accurately based upon the value of the average or standard cow in the herd. This standard value may be calculated by making a detailed valuation at market prices in normal times and then finding the average value per head. The total valuation will vary according to the number of cows in the herd and the quality of the herd as a whole, but the object must be to make the valuation correspond as nearly as possible to *normal* market value without by any chance exceeding it.

The case of cows has been treated in such detail in order to present and analyse general principles which will apply more or less completely to all classes of breeding stock.

In passing, a reference may be made to the valuation of cheese on the dairy farm. This should occasion no difficulty as, if the valuation is made at the date suggested, little cheese will be in stock, and, in view of the extreme difficulty in accurately determining the cost of production, it may be valued at a little under current market price.

Other Classes of Cattle.—Young dairy stock, home-bred and purchased feeding stock, etc., should give little trouble and should almost invariably be valued on a basis of cost up to date. Although it is undoubtedly true that in the case of store cattle purchased for fattening purposes the profit will be largely influenced by the relative market prices per cwt. at buying and at selling, it is nevertheless equally true that neither with such cattle nor in the case of home-bred fat cattle can any real profit emerge until the cattle are marketed. It is only such profit that will pay the rent. It is time that valuers recognised that valuations should be based upon what the farmer *is doing* and not upon what he *might do*. He *might* sell his calves as stores, but what he actually *does* is to sell them as fat bullocks. It is the latter *fact* which the valuer should bear in mind and act upon and not the former *supposition*.

Horses.—Since the number of horses on the average farm is relatively small and the individual values relatively high, each horse should be valued separately. In the case of young horses, not yet broken to work, the valuation should be on a cost basis, whether they are home-bred or purchased. The same principles apply as in the case of young cattle.

Work horses, again, are in the nature of machinery, with the important difference that after being installed they appreciate in value for a certain number of years before depreciation sets in. Probably the following method would suit the majority of cases. Allow a certain figure, say £35, as the value of an average three-

year-old fully broken to work. This may be called the "standard value" of three-year-olds, and should be such a value that the market value is not likely to fall lower, although it may be above the actual cost of production. In succeeding years it may be reckoned that the average horse will appreciate, both intrinsically and in market value, by, say, £5 per annum until a maximum of £45 or £50 is reached, after which depreciation may be allowed at a gradually increasing rate per annum until the horse stands in the books at, say, £2 at 16 or 18 years old. Any marked increase or decrease in quality compared with the standard must, of course, be allowed for, as in the case of valuable pedigree horses. This is doubtless a somewhat arbitrary method of fixing values, but no more so than the usual business method of allowing depreciation on machinery and plant of all kinds. At any rate it is preferable to a valuation on a market basis. Good quality farm horses have increased about 30 or 40 per cent. in value since the early days of 1914, but this does not mean more money in the farmer's pocket: it is just as likely to mean less. With a market basis, a rise in market value might result in a considerable paper profit being shown on the work horses, which is almost as unreasonable as showing a profit on the farm implements, for these also have increased in market value since the war commenced. From a book-keeping point of view work horses are machinery, and should be treated strictly as such.

In valuing purchased work horses, consideration must be given to the purchase price and to any depreciation or appreciation in value since the date of purchase, but care should be taken that the valuation price is never higher than the market value, although it may well be lower. Horses bought at the present high prices are likely to undergo more rapid depreciation in value than in normal times, but the standard value of such horses must also be reckoned higher.

Other Live Stock.—As regards *sheep, pigs* and *poultry*, these should be dealt with upon exactly the same principles as have been outlined for cattle and need not be discussed further.

Taking the above principles of valuation for crops and live stock as established, the following objection falls to be noticed. It may be urged that the cost valuation will not show what capital is actually invested in the farm at the date in question, and it is perfectly true that in the event of bankruptcy or of death, or of a partnership formation, the valuation would require to be upon a strict market basis. But under normal circumstances the fundamental object of making a valuation is, as already mentioned, to assist in fixing the actual profit on the year's actual

financial operations, and this can only be attained by taking cost prices or standard values. No farmer need be alarmed if he is assured that he has rather under-estimated the amount of capital in his farm, for this condition obtains in all sound business concerns, but where the capital is over-estimated it often means that the business is perilously near taking the high road which leads to the bankruptcy court.

The case of the initial stocking of a farm must also be noticed in passing. Here, everything will usually be stocked at market value without any regard for cost of production or standard value. On such a farm, the valuations will gradually fall in amount for several years after entry, but this is to be expected. The stock brought on will not represent a normal stocking, *e.g.*, the cows will be mostly of the younger and more valuable classes, the horses will be largely in their prime, and so on. It is only natural, therefore, that such stock will suffer depreciation until normal conditions are reached, after which the valuations will remain fairly constant in amount, but subject to the factors discussed above.

(*c*) MACHINERY AND IMPLEMENTS.—This class of stock should present no difficulty to the skilled valuer, although it has increasing importance in these days of expensive, complicated, labour-saving machines, such as self-binders and oil-engines. At the first valuation, a detailed list must be made and approximate market value attached to each unit. Thereafter a certain rate of depreciation may be allowed upon the sum total. The rate of depreciation will depend chiefly upon the nature of the machine, the care taken in handling and storing it, and its age. Thus, depreciation is more rapid with very complicated machines, such as self-binders, when compared with simple machines, such as harrows; it will be greater with machines which are liable to go quickly out of date or which are only in the experimental stage, such as milking machines, than with those of a standardised character, such as steam-engines; it will be greater in the first year after purchase than in succeeding years, that is, many machines may be worth as much in the market after working 2 or 3 years as after working 2 or 3 months; and it will be least where the machines are skilfully handled while working and carefully cleaned and stored when idle. Bearing these points in mind, the actual valuation can be fairly made.

The simplest method in succeeding valuations is to write off a certain percentage for depreciation from the book value of the implements at the end of the year and, considering that the machinery will be very varied in character and will include units

of many different ages, with some purchased just the year previous to the valuation, this method will probably give fairly reliable results on the average farm. The rate fixed may run from 8 to 12 per cent., according to the factors discussed above. Under this method, a detailed valuation should be insisted upon at least every five years in order to ensure that the valuations are not too high, although it must be admitted that it is by no means easy to fix the market value of, say, a 10-year-old oil-engine or self-binder.

Some authorities advise making a detailed valuation of machinery every year and the extra trouble thus involved would not be very great. In any case, it would be advisable to value separately a few of the more expensive machines, such as oil-engines, agricultural motors, and milking machines. Even where a detailed valuation is not to be made annually, it might be a good policy to make a complete list of all such stock in order to keep track of the smaller utensils.

Certain other points fall to be noticed, viz.: (1) The depreciation may be written off the original value or off the diminishing value of the implements. In farm valuations the latter method is generally taken. If the same percentage be taken throughout it is clear that this would result in a gradually diminishing amount being written off each year, but this is probably quite sound, since, although the total depreciation is less with old implements than with new, the cost of repairs and upkeep is greater. (2) A limit of depreciation may be fixed for individual machines below which the value will not fall. Thus a set of harrows may cost £4 10*s.* In the first year depreciation may be 20 per cent., *i.e.*, 18s., and in following years the diminishing value may be depreciated by 8 or 10 per cent., until the harrows stand in the books at, say, 8*s.* or 10*s.* This principle is very sound, but can only be applied where the machines are valued separately. (3) Where a system of cost-accounts is being kept the implements should be valued in groups according to the department with which they are chiefly concerned, *e.g.*, ploughs and harrows would come under "crops"; a milking machine and dairy utensils under "cows"; and so on. By this means the cost of machinery may be allocated amongst the various revenue departments with some degree of accuracy. (4) All purchases would be debited to the Implements Account during the year, and if cost-accounts are kept the cost of repairs would also be debited, otherwise the latter should be charged to General Expenses. (5) Since the market value of this class of stock is very problematical, care should be taken to keep the valuation low enough.

(*d*) OTHER ITEMS IN THE VALUATION.—This section will include purchased seeds, manures and feeding-stuffs on hand, and these will, of course, be valued at cost, plus the expense of bringing them to the farm. It will also include tenant's fixtures (sheep-dipper, temporary buildings and fences, etc.) which had been taken over from the previous tenant and which will be valued at cost, less depreciation at, say, 10 per cent. per annum. Any new tenant's fixtures would be included here and would be valued on the same principles as for new machinery. The whole of the tenant's fixtures might be included under class (*c*), but it is preferable to keep them separate, as the accounts could then be introduced as evidence of their value to a succeeding tenant.

There still remain two items, viz., farmyard manure and unexhausted improvements, both of which present some difficulty and involve considerable difference of opinion as to how they should be dealt with in a valuation.

As to *farmyard manure*, there are some who hold that it should not appear in the books at all, but be treated as part of the soil which undergoes a certain cycle of changes from soil back again to soil. However sound this position may be under certain conditions, it is quite untenable where concentrated foods are being purchased and used in large quantities. One may even go so far as to maintain that on many arable-dairying and stock-feeding farms the yearly profit depends very much upon the skill shown in the production and utilisation of this commodity. Surely, then, it is necessary that particular account should be taken of it in the farm accounts. So far as the valuation is concerned, it appears to be hopeless to attempt to fix the cost of production per ton, although it is on this basis that farmyard manure should preferably be valued; nor is it possible, except in a minority of cases, to put a market value upon it. We have thus to fall back upon some arbitrary "standard value" for a certain quality, and, unless good reason can be shown to the contrary, the figures which are used in valuations between outgoing and ingoing tenants may be accepted as suitable for the purpose in view. These will run from about 4*s.* to 6*s.* per cubic yard of 14 to 16 cwt., according to the nature and quality of the manure. The estimation of the quantity on hand is a comparatively simple matter. It should be noticed, however, that where the valuation is made towards the end of May little farmyard manure may be in stock, as it may have been applied to the year's root crops. The only difference here is that the manure would be included in the cost of crops to date, instead of separately.

The remaining item is often ignored by valuers and book-keepers, but on a well-managed farm it may be one of the most important assets the farmer has—more important, in fact, than its market value under existing land laws would lead one to expect. It includes the *unexhausted value of such improvements* as drainage, laying down permanent and, it may be, temporary pasture, application of farmyard manure and of certain artificials, and consumption of feeding-stuffs. Under the Agricultural Holdings Act, the unexhausted parts of such improvements have now a more or less definite market value, which must be based very strictly upon their value to an ingoing tenant, and the valuer must keep this firmly in mind in assessing the amount, or a value may be given to this asset which cannot be realised at the end of the tenancy—the only time it can be realised except indirectly by gradual exhaustion.

In this case one has to follow the custom of the district in regard to outgoing valuations, and after the necessary preliminary assumptions have been settled the method is simple and should give little trouble to the valuer and book-keeper. The determination of these assumptions, however, is a most difficult matter, and the whole question is an extremely wide one, beyond the limits of the present discussion. The principle, however, may be explained with the aid of the following simple example. Suppose a farmer applied 10 tons of basic slag, costing £20, on the land, in October, 1910, how much would this be worth at Lady Day, 1911? Very little benefit would have accrued to the farmer before the latter date, and it may be *assumed* that practically the whole value yet remains in the land. To be on the safe side, this dressing may, however, be valued at £18 at Lady Day, being the sum which could probably be recovered from the landlord in the event of the farmer quitting the farm at Lady Day. During the year 1911-12, it may be assumed that one-half the value will be exhausted, so that at Lady Day, 1912, the valuation would be £9. One-half of the remainder would perhaps be exhausted during 1912-13, so that the Lady Day, 1913, valuation would include £4 10*s.* for this item, and so on, according to the "scale of exhaustion" commonly in use in the district. Other forms of improvement will present greater difficulties, but the valuer who is not qualified to tackle the whole question in the light both of common sense and existing laws and customs cannot be reckoned as fully qualified for the work he takes in hand to do.

In conclusion, two points may be noticed. In the first place, it may be said that other items may also appear in the valuation,

e.g., "acclimatisation value" on hill sheep farms, especially in Scotland; the "tenant-right" on Ulster farms; the "goodwill" on milk-retailing farms, and so on, but enough has been said about the principles of valuation to indicate how it can and should be made in order to ensure the result aimed at.

Secondly, it will be noticed that no mention has been made of the farmer's household effects or of his personal belongings, both of which would have to be considered if the object were to find the capital possessed by the farmer as an individual, as in the event of bankruptcy or of death. The farm as a business is not concerned with the way in which the farm dwelling-house is furnished nor with whether the farmer wears a gold watch or a silver one. It is only concerned with capital which is directly invested in it.

It will be noticed also that it has been assumed that the farmer is a tenant. If he is owner of the farm then, of course, its value would be an important item in the valuation.

As regards the tabulating of the various items in the valuation, little need be said. It is a very simple matter to arrange a method of classifying the valuations which will best suit the system of book-keeping in operation and examples are given in all the regular text-books on farm book-keeping.

A NEW METHOD FOR THE DESTRUCTION OF BACTERIA IN LARGE VOLUMES OF MILK BY MEANS OF ELECTRICITY.

FREDERICK C. LEWIS, F.C.S.,
Assistant Lecturer in Bacteriological Methods in the University of Liverpool.
(From the Bacteriological Department of the City and University of Liverpool.)

THE method described in this article for rendering harmless the bacterial contamination of milk was evolved in an attempt to sterilise milk more efficiently, from a public health point of view, than is possible by the ordinary methods of steam sterilisation.

The essential feature of the method consists in passing a suitable current of electricity through the milk during its passage through a tube connecting a container with a receiving vessel. The electric current so acts that the major portion of all bacteria in the milk is killed, and no chemical alteration in the milk so treated has been observed.

The method may be dealt with under the following heads :—

1. The electrical apparatus.
2. The essential dairy apparatus.
3. The manipulation of the apparatus.
4. The results obtained from a bacteriological point of view.
5. The cost of operating.

1. *The Electrical Apparatus.*—In the first place a suitable supply of electricity must be available or, if not ordinarily available, must be generated. The amount of current used is, of course, dependent upon the size of the apparatus, but the voltage must be normally between 2,000 and 3,000 volts. This current is applied to the milk by means of three electrodes made of copper, and each enclosed in a glass receptacle, or electrode chamber. The electrode chambers communicate with each other by means of stout glass tubing of even bore. The electrode chambers and the intermediate portions of glass tubing are connected by socket joints of india-rubber; the whole being built in sections, and fastened in this manner to facilitate cleaning, and to render the apparatus somewhat flexible. The bore of the glass tube or "lethal tube" is strictly relative to the milk output per hour of the particular installation, and the size of the electrode chamber and its

enclosed electrode is such as to interfere as little as possible with the flow of milk through the apparatus, and, in addition, to allow the copper electrode to command the whole bore fully, so that no milk can escape through the apparatus without being submitted to the full action of the current. The electrode is made of copper, about $\frac{1}{8}$ in. thick, and is connected with the electric cable by means of a flat plate, which, by spring contact, is forced against a similar flat plate directly connected to the electric cable. As previously indicated, a high tension current is used, thus necessitating in commercial use the addition of various devices to render the apparatus safe to the operator. Prior to its entry into the lethal tube the milk flows through an aluminium tube; similarly, as the milk leaves the apparatus it flows through a second aluminium tube, both tubes having a direct earth-connection. Such an arrangement prevents any leakage of current into the containing or receiving tanks. Those handling the milk before and immediately after treatment are, therefore, secure against shock. The lethal tube, with its high voltage connections, is mounted on a slate panel, itself suspended from the back of a glass-panelled upper cupboard. A lower cupboard, the doors of which are automatically closed by the overlapping doors of the upper cupboard, contains the high voltage transformer. A further protection is here introduced. In the framework of the two doors of the upper cupboard switches are placed, which, when the doors are open, are "off," but when the doors are closed are "on." These switches are connected directly with the source of the electric current. When, therefore, the doors are open, the electric current is *of necessity* "off," and the apparatus can only be worked when the doors are closed; the act of opening any of the doors automatically disconnects the electric current. Thus the apparatus is perfectly safe, even when worked by an operator not specially skilled in the theory and practice of electricity. The electricity used normally consists of a low voltage alternating current obtained from the town's mains, or specially generated; this is then passed into a transformer, and the voltage increased to the desired point. Switches, and other controlling gear, are mounted on a switch board from which the whole of the apparatus is worked.

A sectional diagram of the lethal tube and its auxiliary portions is shown on p. 1231.

2. *The Dairy Apparatus.*—The essential dairy appliances at present in use with the apparatus are indicated as follows:—(See diagram).

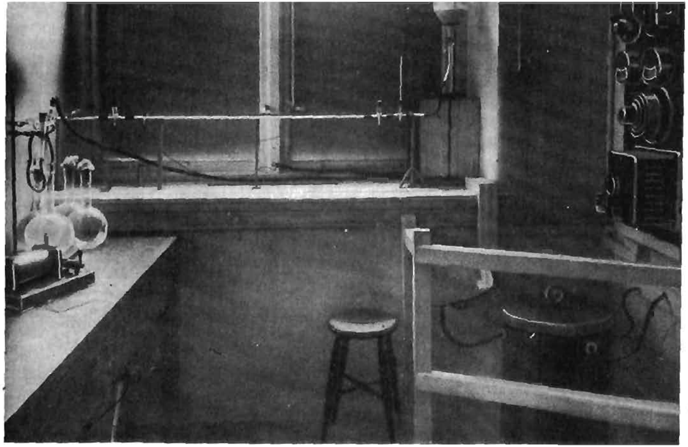
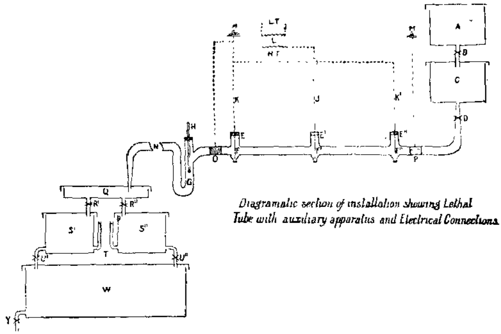


FIG 1.—Photograph of experimental apparatus used in the bacteriological laboratories. On the *extreme right* of the photograph is the switch board from which the motor and dynamo in an *adjoining room* can be regulated. The current to and from the transformer (*visible in lower right-hand corner*) is also controlled at this board.

On the ledge in front of the window, from right to left, the following points can be observed:—(1) Bulb containing supply of milk; (2) Thermometer for indicating temperature of *incoming milk*; (3) Electrode and Electrode Chamber; (4) Length of "lethal tube" leading to the central electrode. After this point a bend occurs in the tube, but the third electrode chamber can be seen on the left with thermometer and outlet for treated milk leading into a flask. The thick high-tension cables may also be seen, with



Diagramatic section of installation showing Lethal Tube with auxiliary apparatus and Electrical Connections.

GUIDE TO LETTERING ON DIAGRAM.

A = covered receiving tank for untreated milk; B and D = taps; C = constant level tank; E, E' and E" = electrode chambers; F, F' and F" = electrodes; O, P = aluminium earthing tubes (the portion of the apparatus between O and P is the "Lethal tube"); K, K' and J = electric cables; L = transformer; LT and HT = low and high tension; M = earth connections; H = thermometer; G = thermometer holder; N = outlet pipe from lethal tube; Q = covered channel leading through tapped pipes, R', R" to S' and S" = auxiliary tanks; T = level guages; U' and U" = outlets from auxiliary tanks; W = Main tank for treated milk; Y = outlet.

A covered main receiving tank (A) discharges through a ball valve into a constant level tank (C). From the latter tank the milk flows by gravity through the lethal tube where, as previously stated, bacterial destruction takes place. From the lethal tube the milk passes through channel (Q) into the small auxiliary testing tank (S'); when this tank is full the flow is diverted into testing tank (S"), and milk from (S') is discharged into the main container (W), and so on, (S') and (S") being used alternately. From the main container (W) the milk may be cooled, and used or bottled as the case may be. The object of the auxiliary testing tanks is explained below. The receiving tanks, etc., must, of course, be sterilised before use.

3. *Manipulating the Apparatus.*—Having made certain that all joints, etc., are tight, and the electrical contacts true, the constant level tank is charged and the milk allowed to flow through the lethal tube. The milk is discharged into a separate tank, and the flow regulated to approximately the correct speed. The current is now switched on and regulated to the correct dimensions. When the flow is

established at its correct speed the temperature of the milk will rise to the normal maximum, and the sterilising process will commence. The milk, now being treated, is allowed to flow for a few minutes, and is then diverted into the first auxiliary tank. The milk used in thus tuning up the apparatus can now be returned to the unsterilised supply. This preliminary manipulation ordinarily requires seven or eight minutes, or perhaps less, for its completion. The process, having been established, the apparatus does not need much attention, the work proceeding almost automatically. The flow, of course, must be unimpeded, and the electrical conditions must be regulated from time to time in order to cope with the slight variations which inevitably occur. These variations are dependent upon minute alterations in the flow and varying electrical resistance of the milk, and other similar factors beyond the control of the operator. If the flow of milk be impeded to any extent, the thermo-electrical balance is upset. When the alteration in flow is only temporary the electrical regulators may be suitably adjusted, and interruption in sterilising efficiency is avoided, but if debris, etc., cause a sudden holding up of the milk, the adjustments may not be made quickly enough, and "flashing" may occur in the tube. This would cause the milk to acquire a burnt taste; so that for this and for other uncontrollable factors the small auxiliary tanks (S'), (S") are introduced in order that, if any milk be spoiled, or if any milk pass through the electrode chambers without being efficiently treated, it is trapped in one of these tanks, and consequently does not come into contact with the main bulk of the treated milk, and, if unspoiled, may be returned to the untreated supply. These small vessels, therefore, represent precautionary emergency measures, but it is only fair to say that they are very rarely needed. In England it is not necessary to cool the milk after treatment unless it is to be used in bulk; but although not necessary, it is perhaps advisable for reasons which will be apparent later.

4. *The Results of Bacteriological Examination of Treated and Untreated Milk.*—All milk contains bacteria, and the problems associated therewith are due to two general factors :—

(*a*) The number of bacteria actually present in the milk, and
(*b*) the types of bacteria present.

These two factors may be regarded from the standpoint of the milk retailer, and from the standpoint of those engaged

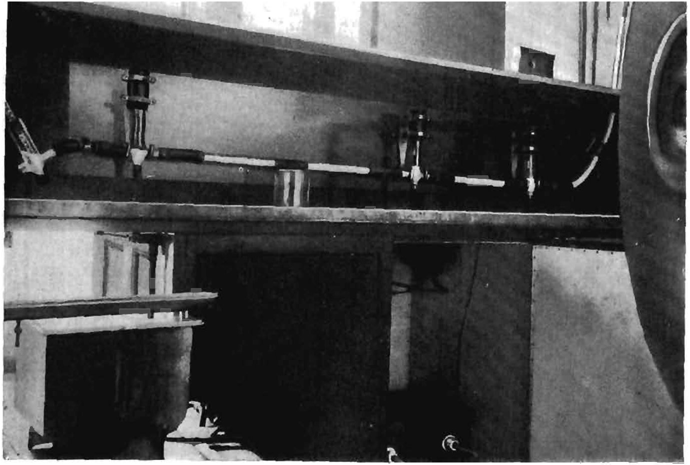


Fig. 2.—The lethal tube, full of milk, can be seen in this photograph, together with three electrode chambers and electrode brackets with curved supporting claws.

The inlet tube on the right and the outlet thermometer on the left are also observable. Terminals of the transformer are shown in the asbestos-lined cupboard below, while in the lower left-hand corner is one of the auxiliary tanks, with the testing trough immediately above it.

Immediately to the right and left of the first and last electrodes, respectively, are shown the aluminium earthing tubes. Owing to the limited space at the disposal of the photographer, a more comprehensive view could not be obtained.

in public health work, or those who use the milk for the manufacture of secondary products. The standard of efficient sterilisation must, therefore, take into consideration the

TABLE I.

Date.	*Control Sample* (untreated milk) 1 c.c. Bacteria present (grown on agar at 37° C.)*	*Electrically Treated Milk 1 c.c. Bacteria present (grown on agar at 37° C.)*
January 26th, 1914	777,000	642
" 27th, "	Uncountable.	327
" 28th, "	125,400	53
" 29th, "	158,400	189
" 30th, "	568,000	316
" 31st, "	567,600	168
February 2nd, "	80,000	100
" 3rd, "	97,500	16
" 4th, "	126,500	22
" 6th, "	35,400	0
" 8th, "	96,400	87
" 10th, "	152,460	130
" 12th, "	112,200	75
" 13th, "	19,840	348
" 14th, "	950,000	49

TABLE II.

Date.	*Control Sample* (untreated milk) 1 c.c. Bacteria grown on neutral red agar at 37° C. (B. coli, &c.)*	*Electrically Treated Milk 1 c.c. Bacteria grown on neutral red agar at 37° C. (B. coli, &c.)*
January 26th, 1914	1,140	0
" 27th, "	180	0
" 28th, "	1,320	0
" 29th, "	29	0
" 30th, "	656	0
" 31st, "	912	0
February 2nd, "	600	0
" 3rd, "	798	0
" 4th, "	105	0
" 6th, "	436	0
" 8th, "	25	0
" 10th, "	17	0
" 12th, "	676	0
" 13th, "	96	0
" 14th, "	432	0

* The "Control" sample is in each case a sample of the milk taken prior to electrical treatment.

destruction of bacteria as influencing the "keeping quality" of the milk, and the destruction of special bacteria of importance from the public health aspect, or the aspect of the manufacturer of milk products.

It is not altogether wise to judge the efficiency of a sterilising process merely by noting the percentage bacterial reduction, for the more impure the milk supply the larger will be the *percentage reduction by any "sterilising" process*, and this percentage reduction may well be accompanied by the survival of the more important or dangerous bacteria present. Some representative bacteriological results from each of these standpoints, as obtained by the electrical method, are, therefore, briefly indicated on p. 1233.

It will thus be seen that, judged from the standpoint of the percentage reduction, the electrical method gives highly satisfactory results, over 99·9 per cent., and judged from the standpoint of the presence of *B. coli* (or manurial contamination) the results could not be improved.

The importance of the absence of *B. coli* and allied organisms is obvious, for it means, amongst other things, the almost total absence in treated milk of the ordinary acid-producing bacilli, and the abolition from the milk of the type of organism associated more or less intimately with infantile diarrhœa. Considerable evidence has also been collected as to the lethal effect of the process upon the organism of tuberculosis.

Effect of Electrical Treatment on B. Tuberculosis.—The experiments were conducted with artificially infected milk and with milk obtained from tuberculous cows, as occasion arose, with both the smaller experimental apparatus and the larger plant at the milk depot.

Passing notice may be given to an experiment in which some milk was heavily infected with fresh human sputum containing very numerous tubercle bacilli. After electrical treatment the centrifuged deposit from the milk was injected into guinea pigs. These animals were killed at the expiration of six weeks, and no trace of tuberculous infection could be found. The control animals, which had been inoculated with the untreated mixture, however, died from sepsis in a few days after inoculation, hence the result, so far as tubercle is concerned, was inconclusive. Apart from this, the result is of importance as showing the general destruction of the other pathogenic organisms, which it will be seen were present in the sputum or the milk in sufficient numbers to cause the rapid death of the control animals.

Experiments on Naturally Occurring Tuberculous Milk.—In April, 1913, milk from a known tuberculous cow was passed through the electrical apparatus; the velocity of the milk was somewhat high, and the amount of current used was small. As was expected, both the control and experimental animals developed well-marked tuberculosis. This experiment being designed to observe the effect of increasing the intensity of treatment, part of the sample was reserved for inoculation, and the remainder then retreated. Again a portion was reserved for inoculation tests, and the remainder given a further treatment. In neither of these cases did the animals inoculated with the treated milk show any signs of tuberculosis.

These results would appear to offer conclusive evidence as to the destruction of tubercle bacilli, and, in addition, serve to illustrate the need for *adequate* treatment of the milk. It is possible, but highly improbable, that, despite apparently efficient mixing, by a series of remarkable coincidences, the milk in the two later stages of the experiment was in each case non-tuberculous owing to the unequal distribution of tubercle bacilli, and that infecting doses were present only in the portions reserved for inoculations in the first stage of the experiment and the controls. Admitting, for the sake of argument, the correctness of the above, the following experiments are of considerable importance:—

A litre sample of milk was obtained from a cow known to be tuberculous, as determined by previous animal inoculation of the milk. This was thoroughly mixed and divided into two equal parts, one of which was electrically treated under normal electrical conditions, and the other was left untreated. The "treated" and "untreated" portions were then dealt with as follows:—

500 c.c. of each was taken and centrifuged as ten separate 100 c.c. samples; the cream and deposit of each 100 c.c. were then injected into guinea pigs, five with the deposit and cream from untreated milk and five with the deposit and cream from treated milk. At the end of the necessary period the animals were killed and examined, with the following results:

TABLE III.

Untreated Milk.		*Treated Milk.*	
Guinea pig No. 1	Tuberculous.	Guinea pig No. 1	All were killed and examined most minutely, but no trace of tuberculosis could be found.
,, ,, 2		,, ,, 2	
,, ,, 3		,, ,, 3	
,, ,, 4		,, ,, 4	
,, ,, 5		,, ,, 5	

Thus there is definite evidence of the destruction of all tubercle bacilli, and this under conditions of infection not likely to be met with in practice. It will be noticed that the milk was the product of one tuberculous cow, whereas the milk supply of a dairy or sterilising depot is the mixed milk of many cows, with therefore, a corresponding reduction in the relative number of tubercle bacilli.

Experiments on Artificially Infected Milk.

1. A sample of milk was freely infected with an emulsion of living bovine tubercle bacilli. After the milk had been thoroughly mixed, two control

animals were inoculated. The remainder of the milk was then treated under "normal" electrical and other conditions and a further two animals injected with the treated milk.

The results were as follows :—

(*a*) The animals inoculated with untreated milk developed tuberculosis.
(*b*) The animals inoculated with electrically treated milk showed no signs of tuberculosis.

2. A sample of milk was sterilised by steam in the autoclave and afterwards infected with the caseous glands of a tuberculous guinea pig; the infected material was added to the milk in the form of an emulsion made by the aid of a pestle and mortar. This artificially infected milk was then electrically treated. The result was as follows :—

(*a*) A guinea pig inoculated with untreated infected milk developed well-marked tuberculous lesions.
(*b*) Guinea pigs inoculated with infected milk after electrical treatment, showed no sign of tuberculosis on post mortem examination.

Further Evidence of the Destruction of the Tubercle Bacillus.— During the testing of a large scale plant further evidence was obtained as regards the destruction of tubercle bacilli. Deliberately infected milk was not used, for the apparatus was built in ordinary dairy premises, but on several occasions the untreated milk was found to be tuberculous, and the corresponding sample of treated milk was non-tuberculous. In those cases where the untreated samples were non-tuberculous, the corresponding electrically treated samples were also non-tuberculous.

TABLE IV.

Showing the Destruction of Tubercle Bacilli by Large Scale Electrical Apparatus.

Date.	*Untreated Milk.*	*Electrically Treated Milk.*
January 31st, 1914	Tuberculous	Inoculated guinea pigs were killed, and on post mortem examination showed no trace of tuberculosis.
February 10th, "		
" 11th, "		
" 16th, "		
" 24th, "		
March 10th, "		
" 24th, "		

It is interesting to observe that some of the animals inoculated with untreated milk died from septic poisoning, the result of bacterial impurities present in the milk, but that no deaths occurred when the animals were inoculated with the milk after it had been treated, except in one case, and that obviously due to other causes.

It would thus appear that this apparatus is in general terms capable of effectively dealing with milk in such a way as to kill the greater portion of all bacteria present, and to destroy the tubercle bacillus, and other pathogenic organisms which may be ordinarily present.

The next point which should be emphasised is that this is accomplished without any alteration in the chemical constituents of the milk so far as can be ascertained by authoritative

chemical analyses.* There is absolutely no change in the taste of the milk. This is shown by the fact that expert dairymen (English and foreign) have been unable to distinguish, as regards taste, between treated and untreated milk. The enzymes or ferments in the milk are not destroyed by the electrical treatment.

Such, then, are the main features of the process briefly discussed; there are, however, several other points which may now be referred to.

A study of the table of results previously quoted will show that, although the bacteria are very greatly reduced in numbers, the milk is not sterilised in the strictest sense. Many groups of bacteria are always wholly destroyed, *e.g.*, the *B. coli* group, but certain other groups appear to contain a few individual members which are highly resistant to the electrical action.

These few remaining organisms will, therefore, ultimately produce changes in the milk, but these changes are always much delayed. Even in the hottest weather in England the milk is perfectly fresh for 3 or 4 days after treatment. The change which ultimately takes place is a characteristic one, viz., mild, pleasant, acid reaction and flavour. The putrefaction which is noticeable so often in stale steam "sterilised" milk has never been observed. This is of considerable importance, not only from an agricultural point of view, but also from the standpoint of infant feeding.

Now that so-called pure-culture ferments are being extensively used in the butter and cheese making industries, it is interesting to mention that milk treated by this electrical process is perfectly suitable as a medium for the action of culture ferments. This has been proved upon several occasions in the laboratory, and also in a special series of experiments made independently in an English margarine factory, where most of the trade ferments were available.

Samples of the treated milk were also submitted to a butter manufacturer, who tested their butter-forming characteristics. His report was that the milk was perfectly satisfactory, both as regards the quality and quantity of butter obtained from it.

5. *The Cost of Operating.*—The apparatus is of a practical nature, and does not require highly skilled labour to work it. That the plant is capable of continuous use is assured, for the power plant is of an ordinary description, and there are no moving parts of the lethal tube. The design is relatively simple, and spare parts are cheap and easily

* See Reports by W. H. Roberts, City Analyst, Liverpool.

fixed. To take to pieces or assemble the apparatus is the work of a few minutes, and cleaning is very easily accomplished. The particular large-scale experimental plant described in this article is of normal design, and was operated daily for three months, during which time some 9,000 gal. of milk were treated and distributed into about 270,000 bottles for infants' use.

The power unit used was an electric motor, but steam, town's gas, or producer gas may also be used. The total cost, including interest and depreciation, wages, and fuel, where electricity at 1·5*d.* per unit is used, is 1·25*d.* per gallon. In the case of town's gas at 2*s.* 8*d.* per 1,000 cubic feet, the total cost is reduced to ·96*d.* per gallon, and is again reduced to ·85*d.* per gallon when producer gas, obtained from anthracite at 30*s.* per ton, is used. The amount of electricity used is about ·43 units per gallon of milk.

In conclusion, the author wishes to express his best thanks to Professor J. M. Beattie, M.D., for permitting him to refer to the experiments in which both are jointly concerned (particularly those relating to the effect of the process on the tubercle bacillus), and for his ever-ready advice and valuable criticisms, and to the Town Clerk of Liverpool for permission to use the blocks for Figs. I. and II.

DESTRUCTION OF RATS IN EAST LOTHIAN.

WILLIAM LAW.

IN a paper on "The Farmers' Pests," read before the East Lothian Farmers' Club in 1909, Mr. A. G. Spence pointed out that rats breed 5 or 6 times in a season, and bear from 5 to 10 young each time, while the young begin to breed when about 6 months old. Mr. Spence was of opinion that the number of rats was increasing, and this he attributed mainly to the killing of owls and kestrels, the natural enemies of the rat.

As a result of this lecture, the Club was satisfied that individual and spasmodic efforts at destroying rats were of little use, and that concerted measures were necessary, because rats when unduly harassed at one farm migrate to another. At a meeting of landowners, land agents, shooting tenants and farmers, called to consider the matter, it was decided to appoint a Standing Committee to receive subscriptions and engage rat-catchers, and it was entrusted to Mr. John Stirling, the

Secretary of the Club, to draw up a scheme of organisation for the county. This was done by dividing the county into districts, and allotting to each district as many parishes as it was considered a killer could effectively cover in the course of a winter. It was arranged that in each district the killer should be supervised by someone voluntarily undertaking the work and not simply by the farmer on his own farm. The subscription was at the rate of 1*d.* per £1 of rental, or, alternatively, 10*s.* per 100 acres. Most of the landowners whose tenants joined the scheme contributed towards its support. Killing was effected mainly by the use of traps, dogs and ferrets. Poison was employed only at the request of the tenant or the owner's gamekeeper.

Operations were started in the autumn of 1909 with 4 men, paid at the rate of 25*s.* each per week, with 1*s.* 3*d.* extra for the maintenance of each dog. The Committee provided each man with about 6 doz. traps, 2 ferrets and 2 dogs.

On the whole, the scheme worked satisfactorily. The area subscribed for was covered twice between 1st November, 1909, and 30th April, 1910, and the Secretary was able to report—(1) That the voluntary assessment and proprietors' subscriptions amounted to £157 6*s.* 1*d.*; (2) that the expenditure on traps, dogs and licences, wages, printing, etc., was £148 14*s.* 2*d.*; and (3) that the rats killed, apart from those destroyed by poison and 650 killed during the threshing of 7 stacks at one farm, numbered 9,486.

In the following year two killers, by means of traps and dogs, accounted for 6,858 rats between 1st October, 1910, and 26th April, 1911.

In the summer of 1911 the County Council agreed to take over the work of the original Committee and to charge the expense to the Public Health rate. A Joint Sub-Committee was formed, consisting of representatives of the Eastern and Western District Committees of the County Council and of the Farmers' Club, and the writer was asked to supervise the killers. With the consent of the County Council the Sub-Committee acquired the traps then belonging to the Farmers' Club and proceeded to take all necessary steps for the effective and systematic destruction of rats in the county. The county was divided into 7 districts, and 7 rat-killers were engaged at a wage of 30*s.* per week. Each killer was required to supply himself with 2 dogs. The Joint Sub-Committee held meetings periodically, at which accounts were passed and reports as to the progress of the scheme submitted.

In the period between 1st October, 1911, and 5th October, 1912, the 7 killers, by means of traps and dogs, destroyed 29,804 rats at a cost to the rates, in round figures, of £450, or ½*d.* per £ on the rental, payable one-half by owner and one-half by occupier. The Western District Committee of Haddingtonshire County Council dropped out of the scheme in 1912, and since then the Eastern District Committee have continued to work in their own area at a yearly cost of about £240, necessitating a rate of about ⅛*d.*, payable one-half by owner and one-half by occupier.

Three rat-killers are now employed at a wage of 30*s.* per week under the supervision of the writer, the killer providing and maintaining his own dogs and ferrets.

In 1912 it was decided that the men should be employed throughout the whole year, as it is difficult completely to kill off the rats in the winter when the homesteads are occupied by stock. The new arrangement also enables the killers to attend all threshings, the importance of which will be realised when it is mentioned that one killer, during one month in the summer of 1913, accounted for 1,000 rats.

All rats killed are taken to a convenient centre near the farm, where they are counted over in the presence of the farmer or his steward. The numbers are then entered in the rat-killer's book in duplicate. The farmer or steward signs the book and retains the duplicate. The book is handed to the clerk of the Eastern District Committee of the County Council on pay day, once a month, when the figures are checked.

During the last 3 years the following numbers of rats have been killed:—

Year ended	25th October,	1913	... ...	20,798
" "	24th "	1914	... ...	23,625
" "	23rd "	1915	... ...	25,636

This makes a total of 116,857 rats killed between 1st November, 1909, and 23rd October, 1915, most of these having been killed during the last 4 years.

Most of the foregoing particulars are taken from an article by Mr. John Stirling.*

Method of Working.—The way in which a rat-killer works may now be briefly described. There is allotted to each man a "district," comprising from 25 to 30 farms, chosen so as to be conveniently worked from the rat-killer's headquarters, which are situated, as a rule, near the centre of his area. The man

* "Notes on the Destruction of Rats in East Lothian." *Transactions of the Highland and Agricultural Society for Scotland, 1914.*

begins with the outer farms and gradually works towards the centre.

Trapping.—Eight doz. light steel traps of saw pattern, with chains attached, are supplied to each man, and 4 doz. can be conveniently carried about at one time. A sufficiency of traps is of great importance, especially during the first and second nights, when, owing to the novelty of the proceedings, the largest numbers of rats are usually caught.

The man moves about among his traps, disposing of the rats as they are caught, and in this way he is able to cover a large part or even the whole of a homestead in the first night. If the homestead is a large one, and two nights are required to complete the catch, the rat-killer takes the lee side first in order that the squealing of trapped rats may be prevented, as far as possible, from reaching those on the other side of the homestead. The traps are set in the usual way, amid the favourite haunts of the rat, and are usually covered with a little oat or barley chaff, care being taken to use the hand as little as possible in the process and to mask the human "smell" by rubbing the hand with soil. If bait is used it may be composed of oatmeal or bread crumbs mixed with an equal proportion of mutton fat from "fallen" sheep; or a little of such mutton may be roasted for the purpose. As the rat is a cunning animal an occasional change of bait is desirable. At day-break all the traps are sprung to avoid accidents with poultry or other domestic animals. Cats should be kept in confinement during the night.

Many rats are also trapped in open ditches, particularly in the vicinity of stackyards or potato clamps. The trap is set close to the water, with the outer edge of the plate next the bank. No covering is needed. The rat is caught as it runs along the water edge. This is one of the surest "kills" in rat-catching.

Ferreting.—When not pressed with night work the rat-killer is able to continue operations during the greater part of the day; with his two dogs, ferrets, and a spade he proceeds to search the hedge-bottoms, his dogs being trained to run one on each side of the hedge. In this way one dog or the other is sure to get the "wind" of any rats that may be lying up. Sometimes a rat will successfully face a ferret in a hole and thus protect several other rats behind. In such circumstances digging out becomes necessary. When the man is digging, one of the dogs remains on guard on the opposite side of the hedge. The dogs most suitable for this purpose are Irish,

Airedale or Rough-haired Fox Terriers. For digging out rats the best spade is a light handy tool, clasped nearly up to the handle, with the "business" part not more than 3½ in. broad and 7 or 8 in. long, and kept well sharpened. If it is found impossible to dig the rats out, or "bolt" them, traps may be set during the day and, to safeguard game from capture, should be covered with light spruce branches or a handful of long grass. If the trap happens to be sprung by a bird, the bird will be thrown upwards. (Dogs soon learn to avoid the traps.) The covering is quickly removed in the evening by means of a small stick.

Rats are often very plentiful in summer and autumn in the hedgerows, whither they are attracted by the grain crops. Other favourite haunts in the field are the potato clamps, which abound in this county. The rats burrow their way in, and not only consume considerable quantities of potatoes, but expose the tubers to the risk of damage by frost. Clamps are generally ferreted, and as several rats usually bolt at once care is taken to shut up all holes in dykes, ditches, etc., in the vicinity, in order to facilitate the work of the dogs.

Stacks may be ferreted successfully in the daytime.

Killing when Threshing.—Threshing operations often provide excellent opportunities for destroying large numbers of rats. Each stack, as it is being threshed, should be surrounded by rat-proof wire netting, held in position by suitable supports about 4½ ft. long and tied securely at the bottom. This gives the dogs an excellent chance: a man also, with a stick, can make a thoroughly clean kill.

Use of Lights.—The writer has never been able to entice rats out into the open with a light of any kind, but has often killed considerable numbers in stables and granaries by suddenly flashing a bright light in their midst; this seems to stupefy the rats and gives a dog an opportunity to kill several before the rest recover from the shock. The flashlight method is very effective on stacks. The rats come to the outside at night, and if a strong light is suddenly flashed on them they can be whipped off with a long stick for the dogs to destroy. As many as 50 at one farm have been killed in this way in a single night.

Flooding.—A good old-fashioned method of killing rats about stables, cow-houses, piggeries, etc., is by flooding. The traps of the drains are stopped up and water is turned on through a hose. The entrance of water into their holes causes the rats to bolt, when they fall an easy prey to dogs.

Rat Virus.—Rat virus, after a trial, was discontinued, as many diseased-looking rats, covered with scabs and without hair,

were to be seen running about from time to time. This, to say the least, was undesirable.

Poisoning.—Killing by poison is sometimes adopted if in the opinion of the rat-catcher and the farmer such a course is desirable. The poison is provided by the County Council, and consists of preparations either of arsenic or of strychnine with oatmeal or maize meal. The rats are fed with meal only for the first 3 nights, then the poison is added. By using meal as the poison medium the rats are unable to carry away pieces which may afterwards be discovered by other animals. If, after poison has been used effectively, the rat-holes are run with gas tar the farmers' premises will remain free from rats for many a day.

During a hard winter, when rats are often short of food, poison may be very effective, but whether poison be used or not it is always advisable to take advantage of a covering of snow to follow up the tracks left by the rats.

There is always, however, a certain amount of danger connected with the use of poison. It seems to create an insatiable thirst, and the rats invariably hang about water courses, wells, etc., and frequently topple in and die in the water, with results that may prove most serious to the public health.

Use of Birds and Animals.—In connection with the suppression of rats, owls and cats often play a prominent part. Some cats, however, are quite useless, while others are invaluable. One summer evening, after a shower, the writer saw 3 owls and 1 cat kill as many as 30 rats in about an hour. The rats emerged from some wheat stacks to catch the raindrops on the thatch and were immediately "lifted" by the owls, while the cat picked off those near the ground. No gamekeeper who knows his business will kill cats anywhere in the neighbourhood of farms.

Weasels and stoats also kill a number of young rats, but they are seldom a match for a full-grown rat, especially a female.

The success which has thus far attended the East Lothian scheme is no doubt attributable largely to the type of rat-killer employed and the terms of his appointment. The best rat-killer, as a rule, is a retired gamekeeper, or a gamekeeper who is temporarily out of employment, as, for instance, through the changing of shooting tenants, but any one who is really keen will soon become a proficient rat-killer. As an occupation for disabled soldiers and sailors rat-killing is specially worthy of attention. At the present time one of our most skilled men has only one arm. Payment at the rate of so much a tail is

generally unsatisfactory, as under that system, after a man has secured the majority of the rats at one farm his natural inclination is at once to move on to another, leaving many uncaught. It is difficult, if not impossible, to exterminate rats, but continuous employment under a concerted and carefully-planned scheme will go a long way towards securing the desired end. It is not sufficient to confine attention to the farm buildings; the fields in summer and autumn must be thoroughly covered, and also the woods in winter where game are hand-fed, for wherever food is to be found rats invariably congregate. It is also important that the rat-killers should provide and train, if necessary, their own dogs and ferrets, in order that all may work together in complete harmony.

SUMMER SPRAYS AGAINST AMERICAN GOOSEBERRY-MILDEW.

Professor B. T. P. BARKER, M.A., and A. H. LEES, M.A.,

University of Bristol.

THE writers have summarised in the present note the work on the summer treatment of American gooseberry-mildew on which they have been engaged during the past two years. The results of this work, in the course of which liver-of-sulphur was used with varying effect, confirm generally the conclusion of Messrs. Eyre and Salmon which was given in the last number of this *Journal* (February, 1916) in an article on "A New Fungicide for Use against American Gooseberry-Mildew." In that article an account is given of experiments conducted during the past two years on means of controlling the American gooseberry-mildew. Messrs. Eyre and Salmon conclude that "Solutions of liver-of-sulphur of the strength generally recommended for use as a fungicide are quite inefficient against the American gooseberry-mildew: at a concentration at which the solution becomes fungicidal, such severe scorching injury is caused to the gooseberry bush as to preclude its use." This conclusion is of considerable importance, since, as is pointed out, liver-of-sulphur has hitherto been considered by many investigators as efficacious against mildews in general and American gooseberry-mildew in particular.

Trial has been made of a mixture which does not appear to have been previously used—a mixture of liver-of-sulphur and a

soft-soap-and-paraffin emulsion, which has given most promising results. How far the liver-of-sulphur is the active fungicidal ingredient has not yet been determined. Probably each of the three constituents is required for full effect. In any case the preliminary results have been so satisfactory that it is desirable to test thoroughly the effect of liver-of-sulphur used in this way before finally rejecting this substance for the treatment of the mildew, especially in view of the frequent use of this substance as a fungicide, and its convenience and cheapness for this purpose. The primary object of this note is to call attention to this mixture, as used in the 1915 experiments, in the hope that it may be tried by other workers during the coming season and its actual value tested under a variety of conditions.

The work was started at Long Ashton during the summer of 1914, in consequence of a slight outbreak of the disease in the plantations at the Research Station. It was decided to attempt to ascertain to what extent the disease could be controlled by summer spraying, the point of view taken being that if the summer stage of the disease could be adequately controlled the amount of the winter stage formed would be so limited that, with the further reduction of the latter by tipping, the outbreak the following season ought to be reduced eventually to insignificance. Details of the 1914 experiments having already been published,* only a short summary need be given here.

The procedure adopted in the first set of experiments on the affected bushes was to apply, firstly, a spray which would kill by direct contact so far as possible the *mycelium* and *conidia* present on the bush, and, secondly, a protective spray to keep the parts on which the fungus had thus been killed free from infection from external sources. A number of fluids of the first type, *i.e.*, "hitting" or "contact" sprays, were tested, including one composed of 4 lb. of liver-of-sulphur and 20 lb. of soft soap in 100 gal. of water. On each of the plots thus treated a series of protective or "cover" sprays, such as Bordeaux mixture, lime-sulphur, etc., were applied. The applications were made at the end of July, the outbreak being a very late one. None of the results was entirely satisfactory, the mildew reappearing fairly generally, although only slightly.

In the course of this experiment it became evident that the "hitting" sprays were all more or less ineffective, because they failed to wet the fungus uniformly owing to the presence of air

* Ann. Report of the Univ. of Bristol Agric. & Hort. Research Station, 1914.

between the *conidiophores* and the *conidia*. The importance of this point has also been emphasised in the paper by Messrs. Eyre and Salmon, who, owing to this difficulty, used their test fluids made up with 1 per cent. of soft soap. The writers, however, found that twice that quantity of soft soap did not suffice to give complete wetting, when the fluids were tested on a practical scale. Under those conditions liver-of-sulphur in the 0·4 per cent. solution mentioned above proved inefficient. Messrs. Eyre and Salmon found that it failed in soap solutions of half that strength, when the percentages of the sulphur compound used were about the amount stated. It is, therefore, probably correct to conclude that liver-of-sulphur used at the rate of 0·3 or 0·4 per cent. in aqueous solutions or in soft-soap solutions is, at the most, of only limited value against mildews. (It is possible that a 1 per cent. solution might wet the less floury mildews, such as pea mildew, but fail with American gooseberry-mildew.)

The failure of soft soap alone to give the spray fluids under trial the necessary degree of wetting power led eventually to the use of soft-soap-and-paraffin emulsion. From previous spraying trials against Woolly Aphis on apple trees it had been found that with the comparatively hard water at Long Ashton the most wetting combination was an emulsion of paraffin in soft-soap solution at the rate of 20 lb. of soap and 2 gal. of paraffin to 100 gal. of water. With soft water not more than 15 lb. of soft soap need be used. This emulsion, both when used alone and when various fungicidal substances were dissolved in it, proved capable of completely wetting the densest patches of mildew. Even when a fungicide was not added to it, it appeared to possess a marked toxic action on the mildew, the *conidia*, so far as could be judged in the original trials by a microscopical examination, being killed after contact with it. The results of subsequent experiments tended to show that the emulsion alone could not be relied on to kill the "summer stage" completely, and on that account it was eventually decided after trial to use it in conjunction with liver-of-sulphur for the main 1915 experiment.

This experiment was an attempt to stamp out, if possible, the "summer stage" of the mildew from a fairly well-isolated gooseberry plantation in the neighbourhood of Weston-super-Mare, with the object of ascertaining if the disease would reappear the following season after this treatment supplemented by winter tipping, and, if so, if the time of the outbreak was delayed sufficiently for the fruit to escape infection.

The fungicide used was the soft-soap-and-paraffin emulsion referred to in a previous paragraph, with the addition of liver-of-sulphur at the rate of 3½ lb. per 100 gal. of the fluid, *i.e.*, a 2 per cent. emulsion containing approximately 0·35 per cent. of liver-of-sulphur.* From the preliminary trials it appeared that, when applied with reasonable care, this fluid was capable of completely wetting and killing the mildew, and that at the same time it caused no scorching or defoliation and no disfigurement of the foliage or fruit.

The plantation treated consisted of bushes of Whinham's Industry and Keepsake, and was situated 100 yd. or more from the next plantation of gooseberries, in which the disease also occurred. The outbreak appeared in May, and by the beginning of June the berries and young shoots of the Whinhams and the young shoots of the Keepsakes were freely attacked. The fruit of the former variety was largely covered with the summer stage and remained ungathered on the bushes throughout the course of the experiment. When the disease appeared to be at its height about the middle of June the spray was applied, care being taken to wet the whole of the bushes thoroughly. An examination of the diseased shoots and berries a few days later showed that the production of new *conidia* had ceased, and that the fungus originally present had apparently been killed completely.

It had originally been intended to spray the bushes again at intervals during the remainder of the summer; but, except for a very slight new outbreak on a few of the shoots of the outermost bushes of the Whinhams plot, no further growth of the mildew occurred. It was, therefore, considered unnecessary to give any further spraying.

There was no damage done by the spray fluid to the bushes except in the case of a few Keepsake plants, which received the last portion of the fluid. In this instance some scorching appeared and was evidently caused by too great a concentration of emulsion owing to lack of agitation in the knapsack machines used. On the few shoots which eventually showed the living "summer stage," the "winter stage" appeared also in due course. Very few *perithecia* were formed, and in none of those examined were ripe spores observed.

* The mixture is made as follows:—In 5 gal. of boiling water 20 lb. of soft soap and 3½ lb. of liver-of-sulphur are dissolved by constant stirring. Two gal. of paraffin (preferably "Solar Distillate" brand) are forcibly sprayed into the hot solution, using a garden syringe with a rose attached for this purpose. For use add 19 gal. of water to every gallon of concentrated emulsion.

The critical test of the experiment is, of course, the reappearance of the disease and the time of the outbreak this summer. As to this, nothing can yet be said, but the experiment last year certainly serves to show that the liver-of-sulphur-soft-soap-paraffin emulsion is capable of drastically reducing the amount of the "summer stage" in an affected plantation and, provided that the spraying is administered as may be necessary, also of correspondingly curtailing the production of the "winter stage." Further than this conclusion it would be at present unwise to go.

It is probable that the character of the weather last season and the heavy crop of berries carried by the bushes prevented the formation of the succulent young shoots on the bushes which are mainly the object of attack, and that the spread of the disease from the few shoots which bore living *conidia* after the spraying was accordingly hindered. On this account no satisfactory conclusion can yet be drawn as to the number of sprayings required to keep the "summer stage" under control. Trials in a plantation of young, vigorously-growing bushes are required for this purpose.

The cost of the mixture at pre-war price per 100 gal. works out as follows:—

	s.	*d.*
Soft Soap, 20 lb. at 14*s.* per cwt.	2	6
Paraffin (Solar Distillate), 2 gal. at 7*d.*	1	2
Liver-of-Sulphur, 3½ lb. at 8*d.*	2	4
Total	6	0

It should be remembered, however, that owing to its good wetting power less solution is used per bush than would otherwise be the case. With soft water 15 lb. of soft soap per 100 gal. would be amply sufficient, thus reducing the price to 5*s.* 4*d.* per 100 gal.

As to the mixture itself, it is believed that, where the treatment of the "summer stage" of mildew by a "hitting" fluid is concerned, the employment of a wetting fluid of the paraffin emulsion type is essential, and, so far as trials to date go, none approaches the 2 per cent. soft-soap-paraffin emulsion for effectiveness and cheapness combined. The choice of an active fungicide to supplement the toxic properties of this emulsion is still an open question, as indeed is the need for the inclusion of such a substance. Liver-of-sulphur was selected, to some degree arbitrarily, for the experiments which have been described, and appears to have acted very successfully: but further work may well show that there are better fungicides for the purpose. In this con-

sulphide, the substance which has proved so promising in the experiments of Messrs. Eyre and Salmon. It seems possible that the effective results with the latter fungicide may have been due not only to its action in the form of a "hitting" spray but in part to its decomposition into volatile substances, which acted in a gaseous condition upon the fungus. Where "vapour" treatment is concerned the wetting properties of the fluid applied are not so vital, and 1 per cent. or less of soft soap in the mixture might then be adequate for effective distribution.

It remains to be added that the liver-of-sulphur-soft-soap-paraffin mixture probably possesses very limited protective properties against reinfection, and that renewed infection from outside sources can doubtless occur freely, even although the fluid may completely clear the plantation under treatment from the original "summer-stage" attack.

SILAGE AS FOOD FOR STOCK.

G. JAQUES.

ECONOMY in the production of milk and beef, and in the feeding of store cattle in winter, is a matter of first importance at the present time.

The value of roots as a succulent, nutritious and highly palatable food for stock is sufficiently attested by the fact that for over two centuries roots have formed the basis of winter rations. On heavy land and in a dry climate, however, such as prevail where the writer farms in Norfolk, the root crop is a very precarious one, and the question of finding a suitable substitute has exercised the minds of farmers for many years, and has latterly become a matter of extreme urgency. This problem the writer has solved to his entire satisfaction by introducing into the rotation an autumn-sown leguminous crop, which is made into silage in a modern stave silo. By this system milk is produced to-day at about 3½*d.* per gal. for food, or, roughly, half what it often costs when roots form the basis of the ration. By the same means the cost of producing beef and of keeping store cattle may also be correspondingly reduced.

Nitrogen being the most expensive manurial ingredient which a farmer has to buy, it must be sound economy to obtain the necessary nitrogen from the air, by growing leguminous plants every other year with the aid only of purchased phosphates.

Since its inception some years ago, this system of farming has given rise to much adverse criticism, but it is nevertheless a fact that several leading East Anglian farmers have adopted it, and speak most highly of the results. In view of the present scarcity and cost of labour, artificial manures and feeding stuffs, there is reason to anticipate a considerable extension of the system in the near future.

The following statement shows the cost of growing the silage crop and of producing milk by its use, in 1915:—

	£	s.	d.
Cost of growing one acre :—			
Rent	1	0	0
Basic Slag		12	0
Ploughing		10	0
Harrowing		1	6
Seed (1½ bush. of tares, ½ bush. of beans, 1 bush. of oats, 1 peck of rye)	1	0	0
Seeding		2	0
Rates		4	0
Steam cultivating twice after crop is removed.	1	0	0
Rolling			9
	£4	10	3

Cost of cutting and getting ready one acre for carting	£0	11	0

Cost of filling silo 16 ft. by 39 ft., capacity 200 tons :—

	£	s.	d.
8 men at 4*s.* per day for 6 days	9	12	0
3 boys at 1*s.* 6*d.* ,, ,, ...	1	7	0
5 horses at 3*s.* ,, ,, ...	4	10	0
Engine and driver at £1 per day for 6 days ..	6	0	0
Silage cutter at 15*s.* per day for 6 days ..	4	10	0
Coal	2	0	0
Beer	2	18	0
	£30	17	0

Thirteen acres filled the silo to the top.

Cost of filling per acre = £30 17*s.* 0*d.* ÷ 13 = £2 7 6

Total cost of silage per acre :—

	£	s.	d.
To grow	4	10	3
,, cut		11	0
,, fill	2	7	6
Interest and depreciation on silo, 10 per cent.	1	3	0
	£8	11	9

Ration as fed to cows from 1st October to 31st December, 1915:—

60 lb. Silage	3·66*d.*
24 ,, Turnips	1·28*d.*
1·6 lb. Concentrates (maize gluten at £10 per ton)	1·71*d.*
	6·65*d.*

This ration fed to 17 Red Poll cows produced 32,254 lb. of milk from 1st October, 1915, to 31st December, 1915, or an average of 2 gal. per day, at a cost of 3·32*d.* for food per gal. The average number of days from calving, on 31st December, 1915, was 163, and the feeding of silage commenced on 20th September, 1915. The low cost per gal. was not obtained from cows at their "flush" of milk or through feeding a proportion of grass in the early period; it was due, presumably, to the high feeding value of the food that formed the base of the ration, and the small amount of concentrates.

The silage was analysed by Mr. Lincoln Sutton, the Norfolk County Analyst, with the following results:—

Moisture	61·31
Albuminoids	4·75
Indigestible Fibre	11·25
Mineral Matter (ash)	3·28
Volatile Acid (acetic)	·45
Non-volatile Acid (lactic)	·78
Digestible Fibre, Chlorophyll, &c. ..	18·18
	100·00

Yearling store cattle have been successfully wintered on 40 lb. per head per day of silage with only water in addition. Beef cattle fed on similar lines to the milking cows are reported to "die" extremely well, being of good colour, firm, and of excellent quality.

Besides supplying a large bulk of valuable food at a low cost, the silage system has many other advantages, among which may be mentioned the following:—

1. The certainty of obtaining a crop.

2. The complete suppression of weeds.

3. The crop can be ensiled in June and July, when the land is generally dry and the days are long.

4. There is no risk of loss from frost as with roots.

5. The land is cleared early and is then made ready for turnips on suitable land, to be folded off. On the heavier soils mustard can be grown and ploughed in, or a bastard fallow taken.

6. A great saving of labour is effected throughout, as compared with roots.

7. More stock can be kept on the farm than is possible with a crop of roots; consequently more dung will be available. This, together with the residue of the slag and the nitrogen accumulated in the soil by the leguminous crop, is sufficient to maintain the land in a high state of fertility.

It may be well to add that since the adoption of the system by the writer 3 years ago (on a farm of 150 acres of second-class heavy land, comprising 105 acres of arable, worked on a four course rotation, and 45 acres of pasture) milk has been sent *once* daily to London, and no complaints of any kind have been made as to its flavour or quality. The wholesale firm to whom it is consigned report that the milk is of very good quality, testing in January last 3·90 to 3·95 per cent. of fat, and 8·81 to 8·86 per cent. of solids-not-fat.

Last year, although the barley yield is said generally to be very poor, the writer obtained 9½ sacks per acre, following the silage, without any manuring; the cleanness of the straw was most noticeable. The barley was sold in the Norwich Corn Hall for 27*s.* per coomb (or 54*s.* per qr.), the top price paid that day being 28*s.* per coomb (or 56*s.* per qr.). The clover plant is very good.

Stock, not roots, are the foundation of a permanent, prosperous agriculture, and it is only by adapting or improving our methods as circumstances demand, that we, as farmers, can maintain or increase our stock and production generally.

THE ENCOURAGEMENT AND IMPROVEMENT OF LIGHT HORSE-BREEDING IN 1914-15.*

THE objects of the scheme initiated by the Board in 1911 for the encouragement and improvement of the horse-breeding industry have been so fully explained in previous issues of the *Journal* that it appears unnecessary to repeat them in a review of the operations for the year ending 31st October, 1915, but as, on the ground of economy, the Annual Report of the Board on the administration of the Light Horse Breeding Grant will not be printed and placed on sale as usual, it may be convenient to refer somewhat fully to the steps that have been taken during the year under review. The outstanding feature of the past

* This article replaces the Annual Report on the Administration of the Grant for the Encouragement and Improvement of the Light Horse-Breeding Industry for 1914-15, which will not be issued separately.

horse-breeding year was the opportunity afforded the War Office of ascertaining from their mobilisation experience the condition of light horse-breeding in the country.

Mobilisation and the consequent impressment of horses has proved—if indeed any proof was needed—that the hunting field is a national asset of the greatest value, providing, as it has done, a reservoir from which the Army has been able to draw a large supply of horses that are eminently suitable for military purposes.

The War Office experience has shown, also, only too clearly, that the civil horse stock of the country is deficient, not only in numbers but also in quality, to meet adequately military requirements on mobilisation. In spite of the fact that many of the finest horses in the world are produced in the United Kingdom it is very evident that we also produce in large numbers horses that are quite unfit for military needs and of little value for any other purpose. The necessity of improving and levelling up the civil horse stock of the country has been urged on the Board by the Army Council on military grounds, with the result that the President of the Board appointed a committee on 3rd August, 1915, to consider and advise as to the steps that should be taken to secure the production and maintenance in England and Wales of a supply of horses suitable and sufficient for military purposes, especially on mobilisation.

A full note as to this committee was given in the issue of the *Journal* for January last, but it may be well to recapitulate that their Report (Cd. 8134) was made to Lord Selborne on the 8th October last, and that their principal recommendations were:—

That the Board of Agriculture and Fisheries should—

1. Institute legislation to require compulsory annual registration by the Board of all stallions that are travelled for a service fee or pnblicly exhibited for stud purposes.
2. Increase the number of King's Premium Stallions.
3. Arrange for the inspection by their officers of stallions recommended for Board's premiums.
4. Continue the brood-mare scheme in those counties in which it has proved a success, and purchase high-class mares for re-sale to selected breeders.
5. Purchase stallions suitable for country service, and, if opportunity for doing so occurs during the present financial year, arrange to obtain the requisite funds.
6. Provide funds for the award of prizes for brood mares and foals.
7. Arrange for a compulsory annual census of horses in as detailed a form as possible, and for more complete returns of horses exported and imported.

8. Reconstitute the advisory council and county committees.
9. Appoint an expert staff of officers to supervise the scheme.

That the War Office should—

1. Purchase a much larger number of horses in England and Wales.
2. Increase their horse peace establishments.
3. Purchase more horses direct from breeders.
4. Purchase remounts when rising four.
5. Purchase specially-selected fillies and leave them with breeders until they have produced and reared foals.

The Board and the Army Council are in general agreement with the recommendations of the committee, and will endeavour to give effect to them as opportunity offers and funds are made available for the purpose.

The impressment of horses for military purposes naturally reduced the stock of mares in the country, and it was anticipated in some quarters that the shortage thus occasioned would militate against the success of the service seasons of the premium stallions. The Board themselves, however, did not share this view and they subsidised 90 instead of 78 stallions, as was the case in 1914, and it is satisfactory to be able to report that the number of mares sent for service in 1915 averaged 82 per stallion, an increase on the returns for any previous year. This increase was no doubt due to the fact that owners of mares anticipate that there will be a big demand at home and from abroad for horses when the War is over, and that it is, therefore, sound policy to utilise every suitable mare for breeding purposes. The reduction of the service fee of a King's Premium Stallion from £2 to £1 was also a further encouragement to mare owners to have their mares covered by the premium horses.

In connection with the anticipated scarcity of brood mares arrangements were made in 1915 for the return from France of mares which were not fit for hard military service, but which appeared suitable for breeding purposes. The mares were selected by an officer of the Board from among the horses in the veterinary hospitals in France, and after a month's rest and isolation at the Board's farm at Pirbright they were sold by auction on condition that they were not to be exported. Approximately 250 mares were so disposed of at an average price of £31, and it is hoped that the purchasers will utilise them for the purpose for which they were brought over, *i.e.*, for breeding.

Service Season, 1914.—Considerable difficulty is experienced each year in obtaining information from owners as to the foals bred from the mares that were served by the premium stallions,

although inquiries are made both by the Board and the owners of the stallions concerned. This difficulty was rendered more pronounced in 1915 owing to the fact that in 1914 a large number of mares which had been served by premium stallions, were purchased by the War Office.

The total number of mares served by the King's Premium Stallions was 3,820, as against 3,281 in 1913, and 2,127 foal fees were paid by the Board. The resulting percentage of foals was 58·09, practically the same as in 1913. Mares purchased by the War Office were not taken into account in calculating the foaling percentage, as no evidence was available as to whether or not the mares actually foaled down.

The average amount paid by the Board on account of a King's Premium Stallion was £254, and the maximum £291. These sums are slightly higher than for the 1913 season. With the addition of the service fee of £2 payable by the owner of a mare, the average earnings of a King's Premium Stallion were £356, and the maximum earnings £423. An additional payment of 100 guineas was made in respect of each of the 12 stallions to which Super-Premiums were awarded.

In addition to the Super-Premiums and King's Premiums above referred to, Board's Premiums were awarded to 28 stallions recommended by county committees, and of the 1,760 mares served 53 per cent. proved to be in foal. The average payments by the Board for each of these premiums was £113 and the maximum £150. With the addition of the service fee of £1 payable by the owner of a mare, the average earnings of a Board's Premium Stallion amounted to £157 and the maximum to £216. These figures are almost identical with those for the 1913 season.

Service Season, 1915.—*Super-Premiums and King's Premiums.*—The Annual Show of Thoroughbred Stallions was held at the Royal Agricultural Hall, Islington, on the 2nd and 3rd March, 1915, the number of premiums awarded being 50 (including 12 Super-Premiums). The entries reached the satisfactory figure of 131, the highest on record.

The Judges were Mr. J. Simons Harrison, Sir Gilbert Greenall, Bart., C.V.O., and Mr. R. G. Carden, who in making their report on the Show said: "We have no hesitation in stating that, "in our opinion, it has exceeded all previous shows in the number "of high-class animals exhibited. All the stallions which gained "premiums were of the sort calculated to mate well with half-

"bred mares, and it is satisfactory to note that ten of these "horses were new-comers, two gaining Super-Premiums."

The average value of the King's Premium was slightly increased, and the earnings of the stallion made to depend more on results than formerly. The service fee was reduced from £2 to £1, and the foal fee increased from 12*s.* 6*d.* to £2. The award of free nominations was discontinued.

The service arrangements of the stallions were supervised by voluntary local committees as in previous years, and their valuable help is much appreciated by the Board.

The number of mares served by the 50 stallions to which King's or Super-Premiums were awarded was 4,318—an average of 86 mares per stallion, which is a very high one when regard is had to the fact that the Board do not take into account or pay for more than 90 services for any stallion. The corresponding figures last year were 3,820 and 76.

Board's Premiums.—The number of Board's Premiums awarded on the recommendation of county committees was increased from 28 to 39, and, in addition, the Board's Thoroughbred Stallion "Adular" travelled at a service fee of £1 in the West Riding of Yorkshire. The average value of these premiums was also increased, and as in the case of King's premiums the earnings of the stallion were made more dependent on the results obtained. The foal fee was increased from 5*s.* to £1, the service fee remaining at £1 as heretofore. The stallions to which premiums were awarded comprised 31 Thoroughbreds, 7 Hunters, and 1 Cleveland Bay. Of the 31 Thoroughbreds, 9 had obtained King's Premiums in previous years while 21 had been exhibited at the London Show in 1915, and 14 of these had been awarded Reserve Cards. And as Reserves are awarded only to stallions of King's Premium merit, it will be noted that nearly half of the Board's Premium stallions were up to the King's Premium standard.

The total number of mares served by the 40 stallions (including "Adular") was 3,067, giving the very satisfactory average of 77 mares per stallion.

Riding Pony Premiums.—On the recommendation of the National Pony Society, premiums of the approximate value of £75 each were awarded in March, 1914, to 6 Riding Pony Stallions for the service of mares not exceeding 14·2 hands. The average number of mares served was 32, and the foaling returns show that the percentage of foals varies from 37 to 72.

Six premiums were again offered in 1915, but only 5 were awarded. The stallions gaining these awards travelled

respectively in the West Riding of Yorkshire, Cheshire, Warwickshire, Gloucestershire and Devonshire, and the average number of mares served by each stallion was 53. This is a distinct improvement on the results obtained the first season.

Premiums to Welsh Cob, Fell and Mountain and Moorland Ponies.—The premiums given by the Board for Welsh Cob Stallions of the old Welsh stamp to serve Welsh Pony mares that are entered in the Welsh Stud Book are much appreciated, and the number last season was increased to 13; 10 premiums were given in 1914 and 8 in 1913. The awards are made on the recommendation of county committees, and free nominations are allotted only to mares that are entered or accepted for entry in the Welsh Stud Book, and which have been passed by a veterinary surgeon as sound for breeding purposes. To Montgomery, Cardigan and Carmarthen 3 premiums each were assigned; to Brecon 2, and to Radnor and Merioneth 1 each.

Five premiums were awarded to Fell Pony stallions selected by judges appointed by the Fell Pony Committee. The stallions are required to serve mares of the Fell Pony type approved by representatives of the committee. The stallions travelled in the following districts:—Appleby, Middleton-in-Teesdale, Kirkby Stephen, Keswick, and Shap, and it is satisfactory to note that the secretary of the Fell Pony Committee reported that the eight entries for the show held at Keswick comprised the best class held under the Board's auspices, any one of the first six stallions being of sufficient merit for the premium. Five of these stallions had won premiums in former years.

The efforts of the Board to improve the breeds of mountain and moorland ponies are being well supported by the various local pony associations. The premiums, which are of the value of £5 each, are awarded only to stallions which are registered by the Board, and the stallions are selected for premiums by a judge appointed by the Board. Assistance is given only in districts in which regulations under the Commons Act of 1908 have been adopted and put in operation, and where associations have been formed to secure observance of the regulations, which prohibit the turning out on the commons of any entire horse, pony, or ass, unless it has been inspected and approved. Eleven premiums were awarded to stallions to roam the Eppynt Hills in Breconshire, eight in the Church Stretton (Salop) district, five in the Black Mountain district (Carmarthen), three in the Penybont district (Radnor), and four in Glamorgan (Fairwood and Pengwern Commons).

Ten premiums were again allotted to stallions to roam selected districts of the New Forest, and the secretary of the New Forest Pony Association wrote to the Board as follows:—

"We have got in the New Forest this year the best lot of suckers I have ever known, and I am pleased to say they are fetching quite 30 per cent. more money than they have for several years."

Purchase of Brood Mares.—This part of the horse-breeding operations was more or less suspended during the year under review so far as fresh purchases were concerned, as, owing to the large Army demands, the price of the mare of hunter type was very much inflated, and county committees wisely refrained from making many purchases. No grants were made to county committees, as in most cases they had more than sufficient balances to carry on, and also because it was considered that the sums available could be utilised by the Board to better advantage in subsidising additional stallions than in providing funds for the purchase of mares at high prices.

Registration of Stallions.—Since 1911 the Board have undertaken to examine stallions for registration free of charge, except in special circumstances, the object in view being the elimination of the unsound stallion which, travelling at a low service fee, enters into competition with premium and other subsidised stallions and does incalculable harm to the horse-breeding industry of the country. The success which has attended this part of the scheme has been most gratifying, and it is clear that owners of stallions now recognise the advantage and commercial value of Government certificates of soundness for their stallions. It is reasonable to infer, also, that owners of mares are beginning to realise that it is false economy to have their mares served by the first cheap and probably unsound stallion that is available when they can obtain the services of a premium or other registered stallion at a low fee. There is much to be said in favour of the compulsory registration of stallions and the advisability of initiating legislation for the purpose is receiving attention.

The number of stallions on the Board's Register has increased progressively from 313 in 1911 to 1,471 in the year under review. This year 103 stallions were refused registration, as compared with 106 the previous year, when the number registered was 1,220.

Of the 1,471 stallions registered this year, 768 were Shires, 219 Thoroughbreds, 167 Ponies, 131 Hackneys, 114 Clydesdales, 48 Suffolk Punches, 11 Hunters, 6 Yorkshire Coach Horses, 5 Cleveland Bays, and 2 American Trotters.

Of the 103 refused, 69 were Shires, 15 Thoroughbreds, 9 Clydesdales, 6 Ponies, 2 Hackneys, and 2 Suffolk Punches.

Fifty-nine of the refusals were in respect of stallions which had not previously been submitted for registration, and the remaining 44 related to stallions which had been accepted the previous year.

The ages of the stallions rejected for registration included all ages from 3 to 16 (inclusive), except 10 and 12. The ages of those passed sound in 1913-14, but rejected in 1914-15, are 4, 5, 6, 7, 8, 9, 10, 12, 13 and 22. A similar wide variation in the ages of the stallions rejected for re-registration occurred in 1913-14, which seems to strengthen the position taken up by the Board against the adoption of an age limit after which a sound horse should be given a life certificate.

The 103 stallions referred to above were rejected on account of the following diseases: Whistling (30), roaring (23), sidebone (14), cataract (12), ringbone (8), stringhalt (4), defective genital organs (4), bone spavin (4), shivering (1); whilst two stallions were refused on account of bad conformation.

Sixteen appeals were made against the reports of the examining veterinary surgeons, and it is noteworthy that only three of them were successful, as compared with seven out of fifteen appeals last year.

The Board wish again to acknowledge the support rendered to their registration scheme by the principal horse societies and their members, and they are glad to say that the Hunters' Improvement and National Light Horse-Breeding Society, the Hackney Society, the National Pony Society, and the Welsh Cob Society are continuing the veterinary examination of stallions at their shows in accordance with the schedule of diseases prescribed by the Board.

The Work of the Commercial Control Branch for the Year 1915.*

General.—The Branch has been occupied during the year mainly with correspondence, inquiries and other business arising out of the difficulties which have been experienced in connection with the transport of agricultural produce and requisites, with alleged contraventions of the Fertilisers and Feeding Stuffs Act, 1906, certain questions relating to the administration of the Sale of Food and Drugs Acts, 1875—1907, and offences under the Merchandise Marks Act, 1887.

* This article replaces the Annual Report of the Commercial Control Branch of the Board for the year 1915, which will not be issued separately.

Delay in Transport of Agricultural Produce and Requisites. —Many complaints of delay in the transit of goods by rail have been received. These delays have arisen from various causes. There has been a considerable increase of traffic due in part to the necessary requirements of the naval and military authorities and to the fact that the shortage of shipping and of labour on canals throws an additional strain on the resources of the railway companies. In a considerable number of cases it was ascertained on inquiry that the delay in delivery was not connected with difficulties of transport but was due to the fact that the consignor was not able to supply the goods.

In the case of agricultural requisites delay might often have been avoided if purchasers had ordered full truck loads. The advisability of ordering truck loads and placing orders in good time has been brought to the notice of agriculturists.

The action taken has been directed towards securing for agricultural produce and requisites the facilities which their importance in relation to the production of food requires at the present time.

Complaints have been investigated as far as possible and representations made to the Board of Trade, the Railway Executive Committee (consisting of the general managers of the railway companies, and appointed for the purpose of co-ordinating the resources of the railways in the general interests of the community), or to the railway companies concerned.

In some cases special instructions have been issued by the Railway Executive Committee, at the instance of the Board, directing that precedence shall be given to certain classes of agricultural traffic.

Conveyance of Fertilisers, Feeding Stuffs, Agricultural Seeds and Agricultural Machines.—Towards the end of the year anxiety was manifested by agriculturists as to the possibility of delay in the delivery of fertilisers, and it was urged that in view of the desirability that every effort should be made to increase the home production of food this traffic was more urgent than many other kinds. The Board accordingly requested the Railway Executive Committee to arrange that special attention should be given to the transport of fertilisers, and the Committee directed that such steps as were possible should be taken by the railway companies to prevent delay occurring in the acceptance and transit of this traffic. A similar communication was addressed to the railway companies by the Committee at the beginning of the year.

A large proportion of the complaints received related to consignments of basic slag, but there are, of course, special difficulties

as regards this material, which is generally produced in districts where large quantities of munitions are now being manufactured.

In connection with complaints as to delays in delivery of agricultural feeding-stuffs the Board ascertained that precedence next to Government traffic is, generally speaking, given to feeding-stuffs for stock.

Towards the end of February complaints were received as to delays in the carriage of agricultural seeds, and, at the instance of the Board, the Railway Executive Committee requested railway companies to give special facilities for the handling of this traffic.

Similar action was taken in May with reference to the transport of agricultural machines, and the railway companies were asked to pay special attention to this traffic also.

Conveyance of Fruit and Returned Fruit Empties.—Comparatively few complaints were received respecting the transport of the strawberry crop. The railway companies were, apparently, able to make arrangements to cope with the demands of this traffic. More difficulty was experienced in regard to the very heavy plum traffic and the railway companies were approached by the Board in certain instances of delay.

In the case of apples and pears it was deemed advisable to warn growers that in order to avoid possible inconvenience it would probably be well to store part of the crop, as it might not be possible to secure conveyance of the fruit, as picked, by rail.

Complaints of delay in the transit of fruit empties were numerous, and difficulties were enhanced by the shortage of carting facilities. The Board are in communication with the railway company principally concerned as to the steps which might be taken by those concerned to minimise these delays.

Fertilisers and Feeding Stuffs Act, 1906.—During the year communications were received from local authorities in England and Wales as to 40 cases of alleged contravention of the Act, and in 18 of these the Board issued consent to the institution of proceedings. In 9 cases fines were imposed and in 3 the proceedings were dismissed. In the remaining instances no proceedings were, for various reasons, taken by the local authorities concerned.

The number of communications received from local authorities on this subject in 1914 was 37, and the number of cases in which consent was issued was 23.

The total number of samples taken under the Act in 1915 was 3,462, of which 628 were unsatisfactory, as compared with 3,857 taken in 1914, of which 610 were unsatisfactory. In England 951 samples of fertilisers were taken, compared with 1,164 in

1914, and in Wales 131, compared with 174 in 1914. The numbers of samples of feeding-stuffs taken in England were 2,025 in 1915, against 2,091 in 1914, and in Wales 355, against 428 in 1914.

Sale of Food and Drugs Acts, 1875–1907.—As in previous years complaints were received indicating that the administration of the above Acts in relation to milk in some respects, and in certain districts, resulted in hardship to the seller of milk which, though containing less than the proportion of fat or solids-not-fat referred to in the Sale of Milk Regulations was, nevertheless, genuine. The position was again considered and, after consultation with the Local Government Board, a circular letter was issued to local authorities suggesting that before proceedings are instituted there should be a preliminary investigation into the circumstances, or that the producer should be given an opportunity of making any report or explanation he may wish. A copy of this circular letter was published in this *Journal* for December, 1915.

The numbers of factories registered under the above Acts in England and Wales at the end of the year were:—Butter factories, 233; milk and butter mixture factories, 7; margarine factories, 27; and margarine cheese factories, 5. The inspection of these factories has been continued so far as circumstances have permitted.

Merchandise Marks Acts, 1887–1894.—Various cases of suspected contravention of the Merchandise Marks Act, 1887, in respect of agricultural produce, came under notice during the year and were investigated by the Board's Inspectors.

Nine prosecutions were instituted for the misdescription of imported meat as English or Scottish, and five for the misdescription of imported tomatoes as English. Proceedings were also instituted in a case in which imported honey was described as Cambridgeshire. Fines were inflicted in all cases.

How to Increase the Production of Food During the War.*

IN an appeal to the farmers and occupiers of land in England and Wales, issued in September, 1915, Lord Selborne said:—

"As Minister of Agriculture in this "present time of War, I desire to appeal to "you who live by the land to assist your "King and Country by producing as much "food as possible on your holdings in the "coming year. It is always a wise precaution for a nation at

* This article is a reprint of Special Leaflet No. 55, which was drafted by a special committee of the Welsh Agricultural Council in conjunction with the Agricultural Commissioner for Wales, and the Board desire to give it the widest possible publicity in the Principality.

The Leaflet is especially intended for distribution in Wales, and copies will not be sent to subscribers to the JOURNAL *without special application.*

"war to provide as much food as it can within its own borders. "You must remember that this war has to be fought with money "as well as men, and every additional pound's worth of food "which you can grow means a reduction in the quantity to be "purchased from abroad, and is, therefore, a direct contribution "to victory.

* * * * * *

"I ask you for your part to devote all your energies to the "task that is set before you, and I am confident that I shall "not ask in vain."

The Welsh Agricultural Council at a meeting held in December last recommended the Board of Agriculture and Fisheries to issue a special leaflet containing suggestions as to how Welsh farmers might assist in increasing the production of food during the war, and this recommendation was approved by the Board.

The Council now desire to draw the attention of Welsh farmers to the following suggestions:—

(1.) **More Attention should be Paid to the Care of Grass Land.**—Experience has shown that much comparatively inferior grazing land can be greatly improved by dressings of basic slag, from 6-10 cwt. per acre being recommended. The Council have no hesitation in recommending very strongly that farmers should greatly increase their use of this manure.

The removal of surplus herbage by thorough grazing or other means, before the slag is applied, is of great importance. In cases where the fields are covered with a thick mat of bent grass, an effort should be made to drag out the bent with a toothed harrow or some other tined implement before the manure is applied. Deterioration has often been proved to be due to the practice of taking hay repeatedly year after year, especially when the hay is cut too late in the season, this practice leading to great excess of Yellow Rattle, Yorkshire Fog and other weeds.

(2.) **Artificial Manures should be more Extensively Used.**—Of an area of about 2,977,000 acres of arable and grass land (excluding mountain and heath) in Wales, little more than about 343,000 acres are under oats, wheat and barley. Even if the area under grain crops is not extended the yield per acre could be substantially increased by the more general application of artificial manures. Dressings of from ½ cwt. to 1 cwt. of sulphate of ammonia, and 1 to 2 cwt. of superphosphate or 2 to 3 cwt. of basic slag per acre have been found very profitable. Dressings similar in character, but slightly more liberal than these, may be recommended for corn when taken after another corn

crop. Artificial manures are equally effective when applied to potatoes, roots, hay and forage crops. In Wales it is of special importance that all land under hay should be liberally manured.

Certain leaflets issued by the Board, a list of which can be obtained on application, give detailed information and directions relating to this matter. Farmers may also receive advice on matters relating to manures and soils from the Adviser in Agricultural Chemistry, University College of Wales, Aberystwyth (for the Aberystwyth area), and the Adviser in Agricultural Chemistry, University College of North Wales, Bangor (for the Bangor area), either directly or through the County Agricultural Organisers.

In connection with manuring, efforts should also be made to prevent waste of liquid manure or of any of the farmyard manure produced at home. Near the coast all the seaweed available should be used as manure. The attention of farmers is also drawn to the need of lime on much of the land in Wales. Farmers are urged to consider the advantages of co-operation in the purchase of manures as well as of feeding-stuffs.

(3.) **New Varieties and Change of Seed.**—Farmers are strongly urged to use new and improved varieties of oats, potatoes, etc., experience having shown that the produce of the land may be very largely increased in this way. It is also suggested by the Council that farmers should consider the advisability of change of seed in connection with cereals, and, particularly, potatoes. The benefit in the case of cereals which follows a change of seed from an early to a less early district is, independently of change of variety, often substantial. In the case of potatoes, efforts might be made to procure Scotch "seed." Irish seed potatoes, if well selected, also frequently do well in Wales.

(4.) **Grass and Clover Seeds.**—More attention should be paid to the purchase of grass and clover seeds. The rye grasses, cocksfoot, red clover, and Dutch clover commonly bought are frequently very unreliable. The rye grasses and cocksfoot so largely employed are often of poor bushel weight. Italian rye grass frequently contains from 10 to 30 per cent. of perennial rye grass, which would give to an inferior sample a quite fictitious bushel weight. Much of the red clover on the market is of South American origin, and this does not succeed so well in Wales as samples of British growth. Cheap samples of white or Dutch clover are often almost worthless, and consist largely of trefoil, suckling clover and weeds. Reliable samples cannot be purchased under 1*s*. 9*d*. to 2*s*. per lb. For further particulars on the subject see others of the Board's leaflets.

Seeds can be tested for farmers in the Aberystwyth College area by the Adviser in Agricultural Botany, University College of Wales, Aberystwyth, and in the Bangor College area by the Adviser in Agricultural Botany, University College of North Wales, Bangor. Arrangements have also been made by the Glamorganshire Education Committee by which farmers resident in that county may have their seeds tested at the University College, Cardiff.

(5.) **Wherever possible Catch Crops should be Grown.** — A catch crop is a crop taken between two ordinary crops in a rotation. Mustard, vetches, rye, rape, etc., can be successfully grown as catch crops in many parts of Wales. Where these or other catch crops are grown, they add materially to the stock-keeping capacity of the farm.

(6.) **Leguminous Crops and Linseed.** — Whether as catch crops or otherwise, every effort should be made to extend the cultivation of leguminous crops, as these answer the double purpose of supplying valuable produce and enriching the soil.

The practice which was once common on many Welsh farms of growing linseed for home use should be revived, as it is one much to be recommended under present circumstances.

(7.) ***More and Better Quality Stock should be Reared.*** — The advice that more stock of better quality should be reared does not necessarily mean less cultivation.

Wherever possible, advantage should be taken of the Board's Live Stock Improvement Scheme. In the case of horses, no sire should be used that does not hold a certificate of soundness from the Board of Agriculture and Fisheries for the year in which it is proposed to use him.

The Council recommend that pigs should be more generally kept. It is perhaps not sufficiently realised that there is a quicker and more profitable return on capital to be had from pigs than from any other class of farm stock, except perhaps poultry. In this connection the Board's Special Leaflet No. 30 (*The Use of Forage Crops for Pig Feeding*) may usefully be consulted.

(8.) **Efforts should be made to Increase the Production of Cheese.** — Cheese has special value as a food, and the Council are of opinion that there are many districts in Wales where more cheese might be made with advantage (*see* Special Leaflet No. 41, *The Importance of Producing more Cheese*). Special arrangements have been made by the Board for giving assistance to local authorities in connection with the formation of local cheese-making classes. Farmers may receive information as to

(9.) **Poultry-keeping should be Extended.** — There is here a source of food supply that can be largely increased without interfering to any extent with the normal stock-carrying capacity of the farm. Not only might the numbers of poultry kept be increased very considerably, but by keeping well-selected birds the egg production can be enormously developed. When it is stated that by selection of a good breed, and good strains of that breed, the number of eggs per hen can be increased probably 100 per cent., and that without increasing the cost of feeding, it is evident that there is great room for improvement.

The Board have recently established a scheme for the development of poultry production in Wales, including the provision of incubating stations for North Wales, and egg-distributing stations for each county in Wales. Day-old chickens from pure strains will be sold from the following incubating stations to residents in Denbigh, Flint, Anglesey and Carnarvon, at a price not exceeding 4*s*. a dozen, carriage forward. Communications in reference to this part of the scheme should be addressed as follows:—

Anglesey	Miss M. Stanton, Lledwigan, Llangefni
Carnarvon	Mr. John Rowlands, Madryn Castle Farm School, Pwllheli.
Denbigh and Flint ..	Miss M. Black, Lleweni Hall Dairy School, Denbigh.

Sittings of 12 eggs from pure-bred hens will be sold, from the 1st December to the 30th April in each year, by each station holder to cottagers and small holders resident in the county at 2*s*. per doz. including the provision of a suitable box for packing, carriage to be paid by the purchaser. Infertile eggs (if returned, carriage paid) will be replaced. A list of the egg distributing stations in each county, with forms of application for sittings, may be obtained from the County Officers shown in List I.*

While the Board will be glad to give assistance in connection with any of the matters referred to in this leaflet if they are communicated with directly or through the Agricultural Commissioner for Wales (at his office at 30, Pier Street, Aberystwyth), farmers are strongly urged to make use of the facilities provided by the Colleges and Agricultural Institutions for giving expert assistance and advice. Communications should be sent either direct, or through the County Officer shown in List I,* to the Professor of Agriculture, University College of Wales, Aberystwyth (for the counties of Brecon, Cardigan, Carmarthen,

printed.

Glamorgan, Monmouth, Merioneth, Montgomery, Pembroke and Radnor), and to the Professor of Agriculture, University College of North Wales, Bangor (for the counties of Anglesey, Carnarvon, Denbigh and Flint). Communications relating specifically to seeds, manures and soils may be sent direct to the Advisers in these subjects as indicated above.

Farmers in the counties of Carnarvon and Monmouth should also take advantage of the services of the staffs of the Madryn Castle Farm School, Pwllheli, and of the Monmouthshire Agricultural Institution at Usk. Communications should be addressed to the Principal in each case.

Communications with respect to the improvement of live stock (horses, cattle and pigs) should be addressed to the Live Stock Officer, University College of Wales, Aberystwyth (for the counties of Brecon, Cardigan, Carmarthen, Glamorgan, Monmouth, Pembroke and Radnor), and to the Live Stock Officer, University College of North Wales, Bangor (for the counties of Anglesey, Carnarvon, Denbigh, Flint, Merioneth and Montgomery).

A War Agricultural Committee has been established in each county in Wales for the purpose of assisting farmers in connection with any problems or difficulties which may confront them in their efforts to maintain or increase the production of food during the war. Difficulties encountered in the purchase of seeds and manures, or in the sale of produce, or with regard to the supply of labour, should be at once communicated to the Secretary of the War Agricultural Committee for the County (*See* List II.).*

Farmers can play no more patriotic part in the present national crisis than by doing their utmost to increase the home production of food. By so doing they diminish the demand for foreign produce, and thereby help to conserve the resources of the nation.

Some of the suggestions made in this Leaflet have been taken from Leaflet No. 31, issued by the Board of Agriculture for Scotland.

The Use of Sulphate of Ammonia as Manure.

IN view of the importance of using every effort to grow heavy crops during the war, it is hoped that farmers, in their own interests and in those of the nation generally, will avail themselves without delay of the present opportunity of obtaining ample supplies of sulphate of ammonia for spring use. The following figures, based

* Not here printed.

on the Board's Returns for the London Market, show that sulphate of ammonia, in common with other manures, has advanced considerably in price since the outbreak of war:—

—	Feb., 1914.	Feb., 1916.	Increase per cent.
	s. d.	s. d.	
Price per unit of nitrogen in sulphate of ammonia	13 2	17 0*	29
,, ,, ,, nitrate of soda..	14 10	21 9½†	47
,, ,, soluble phosphate in superphosphate	1 9	2 10	62
,, ,, insoluble phosphate in basic slag	1 6	1 9½‡	19
,, ,, insoluble phosphate in bone meal	1 7½	1 10½	15
allowed for nitrogen	*15 7*	*18 8*	*20*
,, ,, insoluble phosphate in steamed bone flour	1 4	1 11½	47
allowed for nitrogen ..	*12 9*	*19 4*	*52*

Against the 29 per cent. rise in the price of sulphate of ammonia must be set the proportionately greater increase in the value of the principal farm crops.

In the following statement, based on recent field experiments, an attempt is made to show the average increase in the various crops, and the value of such increase, that may be expected from the use under suitable conditions, of 1 cwt. of sulphate of ammonia per acre. The crops have been valued at prices considerably under those now ruling in the London and other markets:—

	£ s. d.	£ s. d.
Wheat, 4½ bush. @ 55s. per qr.	1 11 0	= 2 1 0
,, straw, 5 cwt. @ 40s. per ton ..	10 0	
Barley, 6½ bush. @ 50s. per qr.	2 0 7	= 2 9 11
,, straw, 6¼ cwt. @ 30s. per ton ..	9 4	
Oats, 7 bush. @ 30s. per qr.	1 6 3	= 1 18 3
,, straw, 6 cwt. @ 40s. per ton ..	12 0	
Rye-grass hay, 10 cwt. @ 100s. per ton ..	..	2 10 0
Meadow hay, 8 cwt. @ 90s. per ton ..	..	1 16 0
Mangolds, 32 cwt. @ 12s. 6d. per ton ..	..	1 0 0
Potatoes, 20 cwt. @ 60s. per ton.. ..	..	3 0 0

Consideration of the foregoing figures shows that there is ample justification for the liberal use of reliable manures at the present time.

* Average of Hull, Newcastle and Newport Markets.
† ,, *Hull, Liverpool, Widnes and Bristol Markets.*
‡ ,, Hull and Newcastle Markets.

Of the two chief classes of manures, nitrogenous and phosphatic, the former are usually the more effective in increasing the yield of the crop. Where nitrogen is given freely, whether in the form of dung or an artificial fertiliser, it is desirable, however, to effect a proper "balance" by applying a dressing of superphosphate (or, in some cases, basic slag, bone meal or mineral phosphate). This prevents undue rankness, hastens maturity, and improves the quality of the produce.

In certain districts it may be possible to obtain nitrogen in the form of nitrate of lime or calcium cyanamide at a somewhat cheaper rate than in the form of sulphate of ammonia, but, for general purposes, the last-named fertiliser will usually be the most suitable and its use is recommended.

To obtain the best results with sulphate of ammonia it should be incorporated with the soil as far as conditions will allow.

The following are examples of manurial dressings (per acre) suitable, in average circumstances, for the crops mentioned:—

Wheat.—1 to 1½ cwt. of sulphate of ammonia, applied before harrowing the wheat in spring.

Barley.—¾ to 1 cwt. of sulphate of ammonia and 2 cwt. of superphosphate, applied at seed time and harrowed in.

Oats.—1 to 1¼ cwt. of sulphate of ammonia, and 2 cwt. of superphosphate applied at seed time and harrowed in.

Hay (Rye-grass and Clover).—1 cwt. of sulphate of ammonia and 3 cwt. of superphosphate applied in March. If clover predominates in the mixture, sulphate of ammonia should be reduced to ½ cwt.

Hay (Meadow).—1½ cwt. of sulphate of ammonia and 3 cwt. of superphosphate applied in March.

Pasture, Beans, Peas, Lucerne, Sainfoin, Vetch Mixture.—½ cwt. of sulphate of ammonia and 5 cwt. of superphosphate.

Mangolds. —

With Dung.—1 cwt. of sulphate of ammonia, 4 cwt. of superphosphate, 4 cwt. of salt, applied in the drills; 1 cwt. of sulphate of ammonia or nitrate of soda applied after thinning.

Without Dung.—1½ cwt. of sulphate of ammonia, 6 cwt. of superphosphate, 4 cwt. of salt, applied before the seed is sown; 1 cwt. of sulphate of ammonia or nitrate of soda applied after thinning.

Swedes, Turnips, Kale, Rape.—

With Dung.—½ to 1 cwt. of sulphate of ammonia and 4 cwt. of superphosphate applied in the drills.

Without Dung.—1 to 1½ cwt. of sulphate of ammonia and 6 cwt. of superphosphate applied before the seed is sown.

Potatoes.—

With Dung.—1 cwt. of sulphate of ammonia and 4 cwt. of superphosphate applied in the drills.

Without Dung.—(After ley) 2 cwt. of sulphate of ammonia and 5 cwt. of superphosphate applied in the drills.

Phosphatic Manures for Use along with Sulphate of Ammonia.—In purchasing superphosphate preference should be given to the cheapest form, per unit of soluble phosphate, usually the 35 per cent. quality. Three cwt. of superphosphate 35 per cent. contains the same amount of soluble phosphate as 4 cwt. of superphosphate 26 per cent., and by using the former a saving is effected in respect of both carriage and handling. Superphosphate is, generally, the best form of phosphatic manure for all arable crops, and it may be mixed with sulphate of ammonia before application. Basic slag (which must not be mixed with sulphate of ammonia) may be substituted for superphosphate in a district of ample rainfall and when the land is deficient in lime and rich in organic matter; otherwise it should be preferred only when the price per unit of citric soluble phosphate is considerably lower than the corresponding price of water soluble phosphate in superphosphate. (At the time of writing the cost, at London, of one unit of citric soluble phosphate in basic slag is 2*s.* 7½*d.* as compared with 2*s.* 8½*d.* for one unit of water soluble phosphate in superphosphate, 35 per cent., and the latter is to be preferred except for soils deficient in lime.)

Where difficulty is experienced in obtaining a sufficient supply of either superphosphate or basic slag, a mixture of superphosphate and a finely-ground soft mineral phosphate may be employed instead; no more mineral phosphate being used, for general purposes, than is absolutely necessary. For grass and turnip land, rich in organic matter and situated in a rainy district, a dressing of ground mineral phosphate may take the place of either superphosphate or basic slag.

Another method of supplementing the supply of superphosphate is to mix it with bone meal or steamed bone flour, whichever is cheaper. (The unit price, in London, of insoluble phosphate at the present time is 1*s.* 11*d.* in bone meal, 1*s.* 11½*d.* in steamed bone flour and 1*s.* 6*d.* in raw mineral phosphate).

The current unit prices and notes on the uses of manures are published monthly in the Board's *Journal* (see pp. 1281-5). The subject of manures and manuring is dealt with in some detail in several of the Board's leaflets, copies of which may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, Whitehall Place, London,

The Manuring of Cottage Gardens and Allotments.*

OF the chief food ingredients required by plants only three, viz., nitrogen, phosphates and potash, have to be applied directly in the form of manure. Farmyard manure contains all three, but artificial fertilisers usually contain only one or two of the necessary ingredients.

A fourth substance, lime, is required, not so much as a plant food as on account of its action on the soil.

For information as to the principles of manuring and the properties of the different fertilisers, readers are referred to the Board's Leaflet No. 72 (*The Purchase of Artificial Manures*).

Farmyard Manure.—The manure at the disposal of the cottager and allotment holder is often poor in quality as compared with farmyard manure made in well-constructed cattle-feeding yards. It is apt to contain too much straw, or other litter, and too little of the animal excreta. In view of the bulk of material applied, therefore, the crop returns obtained from its application are often disappointing.

When the manure has to lie for some time in a heap before application it should be covered with about 6 in. of soil in order to preserve the fertilising material.

In the case of heavy soils the manure is best dug in during autumn and winter; in the case of light soils this should be done in spring, some time before cropping.

The undecayed portions of the manure should preferably be used for the green crops (cabbage family), the more completely decayed portions for the root, fruit and flower crops.

An average market-garden dressing of manure would be about 2½-3 cwt. per rod (30¼ sq. yd.). A large barrow-load of moderately decayed manure will usually weigh about 1 cwt.

Where the full dressing of ordinary manure cannot be obtained, artificial manures, as indicated below, may be applied with advantage.

Potatoes.—Where the crop is grown on the flat, sulphate of ammonia should be applied on the surface just before the first earthing up, at the rate of ½ oz. per sq. yd. (1 lb. per rod, or 1½ cwt. per acre). Where potatoes are planted in drills the sulphate of ammonia may be applied in the drills at the time of planting.

Superphosphate of lime should be applied at the rate of 1½ oz. per sq. yd. (3 lb. per rod, or 4¼ cwt. per acre), and may be forked in lightly before planting on the flat, or applied in the drill at the time of planting; or, superphosphate and steamed

* This article is a Reprint of Special Leaflet No 56, just issued, copies of which will not be sent to subscribers to the *Journal* without special application.

bone flour may be mixed in equal proportions and applied when planting at the same rate as in the case of superphosphate alone.

Cabbage Family.—All the members of this group respond to applications of nitrogenous manures.

Sulphate of ammonia should be applied at the rate of ½-¾ oz. per sq. yd. (1-1½ lb. per rod, or 1½-2 cwt. per acre) before the first earthing up, or as soon as growth starts.

Where cabbage crops are slow in "hearting," and turnip crops refuse to "bulb," phosphates are usually deficient.

Superphosphate should be applied, alone or in combination with steamed bone flour, at the rate of 1 oz. per sq. yd. (2 lb. per rod, or 3 cwt. per acre) at the time of planting, or before the first earthing up.

In inland districts, where allotment crops on light and medium soils are liable to suffer from drought, salt is very helpful and will usually increase the crop. It should be applied at the rate of 1 oz. per sq. yd.

Pea and Bean Family.—Crops belonging to the pea and bean family can usually provide themselves with sufficient nitrogen.

A mixture of superphosphate and steamed bone flour, in equal proportions, should be applied to the ground before or after sowing the seed at the rate of 1 oz. to 4 yd. in length of drill.

The manure should never be sown in the bottom of the drill so as to come in direct contact with the seed.

Onions, Leeks and Celery.—Sulphate of ammonia should be applied at the rate of ½ oz. per sq. yd. (1 lb. per rod, or 1½ cwt. per acre), with superphosphate and steamed bone flour, mixed in equal proportions, at the rate of 1 oz. per sq. yd. On light soils, liable to dry out, salt may be given with advantage (1 oz. per sq. yd.). These crops should all be manured in the early stages of growth.

Carrots, Parsnips and Beet.—Sulphate of ammonia should be applied at the rate of ½ oz. per sq. yd. after singling. Superphosphate and steamed bone flour, mixed, at the rate of 1 oz. per sq. yd., should be applied before sowing the seed. On dry soils, 1 oz. of salt per sq. yd. may be applied before drilling.

Lettuce, Spinach and Radishes.—These are greatly helped by applications of sulphate of ammonia, which should be applied at the rate of ½ oz. per sq. yd., in the early stages of growth. Where radishes do not "bulb" readily, superphosphate, at the rate of 1 oz. per sq. yd. should be applied to the soil before sowing.

Where the soil is known to be overstocked with organic matter (containing nitrogen), producing a very rank growth of leaf, the

sulphate of ammonia should be withheld. This reservation applies to all the crops dealt with in this article.

Liquid Manure for Fruit and Flower Crops.—One peck of poultry manure or 1 peck of sheep droppings placed in a 40-gal. cask and filled up with water will, after standing 24 hours, make an excellent liquid manure if applied while fruit is swelling and, in the case of flowers, while the blooms are opening; 2 gal. per sq yd. should be applied weekly.

Where the above materials cannot be obtained, ¾ lb. sulphate of ammonia and 1 lb. superphosphate in 30 gal. of water will make a safe liquid manure, which may be applied at the rate of 2 gal. per sq. yd.

General Considerations.—The recommendations made above are drawn up to meet the conditions now existing with regard to the supply of chemical manures. Potash salts are hardly obtainable, but wood ashes, which contain potash, should be collected and applied at the rate of 1 oz. per sq. yd. to soil in which potatoes, peas, beans, carrots, parsnips and onions are to be grown. The richest ash is produced by hedge clippings, prunings of fruit bushes, nettles and coarse-growing weeds burnt before they are fully ripened. The ash of timber may contain little potash. Ash must be collected as soon as possible after burning, as rain quickly washes out the potash.

Recent experiments tend to show that members of the cabbage family can avail themselves of the stores of potash already in the soil to a greater extent than most other crops, and this circumstance should be borne in mind while potash is scarce.

On heavy soils, and soils rich in organic matter, basic slag may replace superphosphate, particularly in districts with a good rainfall. The quantity used should be from one and a half times to twice as much as is recommended in the case of superphosphate.

The present prices of the manures referred to in this article are about as follows, when bought in quantities of 1 ton or more:—

		Per ton. £	s.	d.
Sulphate of Ammonia	20 per cent. of Nitrogen ..	17	0	0
Superphosphate ..	35 per cent. of Soluble Phosphates.	5	0	0
Steamed Bone Flour	1 per cent. Nitrogen and 60 per cent. Insoluble Phosphates.	7	0	0
Basic Slag	20-30 per cent. of total Phosphates	1 to 2	14 10	0 0
Agricultural Salt ..	.. .. ..	1	12	0

Allotment holders should order their manures co-operatively so as to save on the carriage and secure the advantage of the lower prices at which dealers are prepared to quote for considerable quantities.

The prices charged for small quantities of 1 cwt. or less vary very much with the district and the cost of carriage from the nearest manure works.

The Manuring of Corn in the Spring of 1916.*

Autumn Wheat.—Land which has received 10 loads or more of dung per acre for wheat seldom receives further manuring in spring, nor, in the case of land in good condition would manure be used after a root crop, or a good clover root. The present need, however, for producing as much wheat as possible is so important that, even in such cases as those mentioned, the young crop should be closely watched and prompt aid given if necessary. In the case of most crops (including crops on poor land dressed with sulphate of ammonia in the late autumn) the farmer should make up his mind that a top-dressing is desirable this year; for, in view of the probable price of wheat, there is every likelihood that suitable dressings of artificial manures will be unusually profitable.

The most important manurial element for wheat is nitrogen, which as a rule this year will be best applied in the form of sulphate of ammonia. From 1 to 1½ cwt. per acre, according to circumstances, should be given as soon as the risk of severe frost is past. If more than 1 cwt. is applied, it is desirable to give the manure in two dressings at an interval of not less than a fortnight. The later dressing should usually be applied before the beginning of April in the Eastern Counties and South of England. If sulphate of ammonia is skilfully used, as much as 1¾ cwt. per acre may be profitably used in spring. With a view to hastening maturity, and improving the quality of straw and grain, about 2 cwt. per acre of superphosphate might be applied any time in March to land needing phosphates.

Spring Wheat.—Unless the soil is highly fertile it will, as a rule, be desirable to apply some artificial manure for spring wheat, with the two-fold object of encouraging growth and hastening maturity. A dressing of 1 cwt. to 1¼ cwt. of sulphate of ammonia and, on poor land, 2 to 3 cwt. of superphosphate per acre, will usually suffice. The manure should be applied before the final

* Reprint of the revised edition of Special Leaflet No. 23, copies of which can be obtained free on application.

harrowing, or superphosphate alone may be applied at that time and 1 cwt. to 1½ cwt. of sulphate of ammonia may be top-dressed in the first half of April. If the spring is wet, and the young wheat is yellow and backward towards the middle of April, a nitrogenous manure will certainly prove useful.

Barley.—After mangolds or other roots which have been liberally manured with dung and artificials, or after turnips which have been folded, further manuring will usually be unnecessary. After a white straw crop, or if in any circumstances manuring is considered desirable, ¾ cwt. to 1 cwt. of sulphate of ammonia and 3 cwt. of superphosphate per acre should be well mixed and harrowed into the land at seed time.

Where barley is liable to lodge, the nitrogenous manure should be reduced to half the quantity or be omitted.

Oats.—In the later districts where the growing of spring wheat would be attended with risk, and in all districts known to grow oats satisfactorily, farmers would be well advised to devote particular attention to securing a heavy crop this year. After pasture of good quality no manure may be necessary, but after most other crops, it will probably pay well to apply manure unless the land is in a high state of fertility. In most climates ¾ to 1 cwt. of sulphate of ammonia either alone or mixed with 2 cwt. of superphosphate and applied at seed time, should give satisfactory results. In late-ripening districts, or on deep, productive land, a smaller quantity of sulphate of ammonia should be used. On light land, particularly in the drier districts, or if in any circumstances it seems necessary to help a weak plant, a top dressing of 1 to 1¼ cwt. per acre of nitrate of soda may take the place of sulphate of ammonia. The application of nitrate of soda should not be too long delayed after the plant is up, or ripening will be retarded. It should usually be applied when the crop is 3 to 4 in. high.

Straw.—In addition to increasing the supply of home-grown grain, the use of suitable manures provides the farmer with more straw. The importance of this under present conditions can hardly be over-estimated. A bulky straw crop helps to suppress weeds, and thus saves labour in connection with future crops. Straw is a valuable substitute for hay, which at present is being largely sold off the farm, and it is the best means at the farmer's disposal of increasing and conserving the manure heap. In the event of a shortage of roots, straw "chaff" is practically indispensable. For fodder purposes, oat straw is undoubtedly the

strawed varieties, which stand manuring best, can be improved in palatability by fairly thick sowing without serious risk of "lodging." To the same end, a stout-strawed variety is sometimes sown in mixture with one of the finer-strawed kinds. Further information on this subject is contained in Special Leaflet No. 47 (*The Use of Straw for Fodder*).

Notes on Feeding Stuffs in March: *From the Animal Nutrition Institute, Cambridge University.*

Prices.— On account of the wide variation in prices of the same article of food at different markets it has been found necessary again this month to compile lists of prices per food unit for each separate market. The tables are, therefore, set out on exactly the same plan as last month.

On the whole, prices per food unit are within a penny of the prices of last month, the majority of foods showing a reduction. Maize, maize meal and Burmese rice meal have risen in price and English oats have remained at their former level; otherwise, starchy foods have fallen by from ½*d.* per food unit in the case of Argentine oats to 2½*d.* in the case of wheat pollards. Notable advances in cost per food unit are Egyptian rice meal (5¼*d.*), Burmese rice meal (3*d.*), malt culms (2¼*d.*), English dun peas (2*d.*), and Argentine maize (1¼*d.*). Chinese beans are cheaper by 2½*d.*, English maple peas by 1¼*d.*, and Egyptian cotton seed by 1¼*d.*

Thanks are due to Professor R. G. White, University College of North Wales, Bangor, and Mr. G. H. Garrad, Wye College, for information as to the use of palm-nut kernel cake for sheep. In their hands this feeding-stuff has proved a safe and useful food for fattening sheep. Several other correspondents have been good enough to send information on various points.

Suggested Rations for March.— *For Horses.*—The difficulty mentioned last month of working out a cheap and satisfactory ration to replace oats for horses, on account of the high price of all starchy foods, is accentuated this month by the rise in price of rice meal. The following mixture is suggested:—

Dried brewers' grains	4 lb.
Bran, pollards, sharps or middlings, whichever is cheapest	4 "
Linseed cake	2 "
Crushed beans	1 "

This mixture is richer than oats in protein, and has rather a higher feeding value. Eleven pounds of it should be used to

replace 12 lb. of oats. The proportion of straw chaff may also be increased, and the diet will be improved by the addition of a few mangolds.

TABLE I.

Feeding Stuff.	Digestible Food Units.	Approximate prices per ton at the end of February.											
		London.			Liverpool.			Hull.			Bristol.		
		£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Soya Bean Cake	122·3	11	16	3	12	5	0	11	5	0		—	
Decorticated Cotton Cake	126·3	12	16	3	13	5	0		—			—	
Indian Linseed Cake ..	123·1	12	13	9	13	5	0		—			—	
English Linseed Cake ..	120·1	13	2	6	13	15	0	13	0	0	13	12	6
Bombay Cotton Cake ..	65·3		—		10	7	6	10	0	0		—	
Egyptian Cotton Cake ..	71·9	10	0	0	10	10	0	10	7	6	10	12	6
Coconut Cake	102·6	*10	12	6	10	15	0		—			—	
Palm-nut Kernel Cake ..	90·5	9	10	0	9	5	0		—		9	17	6
Ground-nut Cake	145·2	†12	0	0	11	0	0	12	0	0	11	17	6
English Beans	99·5	11	17	11	14	0	0	12	4	3	12	12	8
Chinese Beans	101·2	9	11	4	12	2	8		—			—	
English Maple Peas ..	97·2	14	4	5		—		14	6	8		—	
English Dun Peas ..	97·2	12	13	4		—		14	0	0		—	
Calcutta White Peas ..	97·5	17	2	3		—			—			—	
American Maize	93·8	13	1	4	12	12	0		—			—	
Argentine Maize	94·2	12	2	8	12	10	2	12	8	6	12	9	8
Maize Meal	86·5	13	0	0	13	12	6	13	2	6	12	15	0
Maize Gluten Feed ..	121·6	11	0	0		—			—		12	10	0
Maize Germ Meal ..	99·2	12	0	0	13	0	0		—		12	12	6
English Feeding Barley ..	83·0		—			—		15	2	5	12	12	0
English Oats	75·4	12	0	0	12	8	11	12	0	0	11	13	4
Argentine Oats	75·4	11	19	6	12	0	7		—		11	19	6
Malt Culms	69·9	8	12	6	9	0	0	8	0	0	8	2	6
Brewers' Grains (dried) ..	84·5	‡ 9	0	0		—		8	10	0	9	10	0
,, ,, (wet) ..	21·1	§ 1	7	0		—		1	10	0		—	
Egyptian Rice Meal ..	78·7	13	0	0		—		10	17	6	10	15	0
Burmese Rice Meal ..	78·7	12	0	0	10	10	0		—			—	
Wheat Middlings	93·4	10	2	6		—		10	0	0	11	7	6
Wheat Sharps	86·3	10	5	0	10	10	0	10	5	0	10	5	0
Wheat Pollards	81·9		—		9	7	6		—			—	
Wheat Bran	77·5	9	10	0	9	5	0	9	10	0	9	2	6
Wheat Bran (broad) ..	79·9	10	5	0	10	0	0	10	5	0	9	12	6
Feeding Treacle	60·0	9	18	9	10	15	0		—			—	
Linseed	153·5	20	17	4	26	0	0	22	12	4	20	17	4
,, Oil	250·0	45	0	0	48	0	0	43	10	0	49	15	7
Egyptian Cotton Seed ..	108·6	14	0	0		—		14	10	0		—	
Brazilian ,, ,, ..	107·6		—			—			—			—	
Cotton Seed Oil	250·0		—		55	0	0		—			—	

* 2nd grade, £10 5s.
† ,, ,, £11 10s.
‡ Porter grains (London), £8 15s.
§ Porter grains (London), £1 4s.

For Milch Cows.—The rations suggested last month may be continued, but Ration II. may be made cheaper by the substitution of tail corn for rice meal. The cheapest ration for milch cows which has come under notice is a very large allowance of

roots—mangolds—with usual quantities of hay and straw, and no concentrated food except ground-nut cake.

The following ration has been worked out on these lines for a cow of 10 cwt. live-weight, giving 2 gal. of milk per day:—Mangolds, 84 lb.; hay, 10 lb.; straw, 10 lb.; and ground-nut cake, 2 lb. For each extra gal. of milk per day above 2 gal. the diet should be increased by 1½ lb. of ground-nut cake, but the whole amount of ground-nut cake should not exceed about 4 to 5 lb. per head per day. If the milk yield exceeds 3 gal. the allowance per extra gal. should be 1 lb. of ground-nut cake, 1 lb. of dried grains, bran or other food of that kind.

TABLE II.

PRICES PER FOOD UNIT. LONDON.

	s.	d.		s.	d.
Brewers' grains (wet) ..	1	3½	Wheat bran (broad) ..	2	6¾
Gronnd-nut cake ..	1	7¾	Argentine maize ..	2	7
Maize gluten feed ..	1	9¾	Egyptian cotton seed ..	2	7
Chinese beans	1	10¾	English dun peas ..	2	7¼
Soya bean cake	1	11¼	Linseed	2	8½
Decorticated cotton cake	2	0¼	Egyptian cotton cake ..	2	9¼
Coconut cake	2	0¾	American maize.. ..	2	9½
Indian linseed cake ..	2	0¾	English maple peas ..	2	11
Palm-nut kernel cake ..	2	1¼	Maize meal	3	0
Brewers' grains (dried) ..	2	1½	Burmese rice meal ..	3	0½
Wheat middlings ..	2	2	English oats	3	2¼
English linseed cake ..	2	2¼	Argentine oats	3	2¼
Wheat sharps	2	4½	Egyptian rice meal ..	3	3½
English beans	2	4¾	Feeding treacle	3	3¾
Maize germ meal ..	2	5	*Calcutta white peas* ..	3	6¼
Wheat bran	2	5½	Linseed oil	3	7¼
Malt culms	2	5½			

TABLE III.

PRICES PER FOOD UNIT. LIVERPOOL.

	s.	d.		s.	d.
Ground-nut cake ..	1	6¼	Argentine maize.. ..	2	7¾
Soya bean cake	2	0	Burmese rice meal ..	2	8
Palm-nut kernel cake ..	2	0½	American maize.. ..	2	8¼
Coconut cake	2	1¼	English beans	2	9¾
Decorticated cotton cake	2	1¼	Egyptian cotton cake ..	2	11
Indian linseed cake ..	2	1¾	Maize meal	3	1¾
Wheat pollards	2	3½	Bombay cotton cake ..	3	2¼
English linseed cake ..	2	3½	Argentine oats	3	2½
Wheat bran	2	4¾	English oats	3	3½
Chinese beans	2	4¾	Linseed	3	4¾
Wheat sharps	2	5¼	Feeding treacle	3	7
Wheat bran (broad) ..	2	6	Linseed oil	3	10
					4¾

TABLE IV.

PRICES PER FOOD UNIT. HULL.

	s.	d.		s.	d.
Brewers' grains (wet) ..	1	5	Cotton seed	2	8
Ground-nut cake ..	1	7¾	Egyptian rice meal ..	2	9¼
Soya bean cake	1	10	Egyptian cotton cake ..	2	10½
Brewers' grains (dried) ..	2	0¼	English dun peas ..	2	10½
Wheat middlings ..	2	1¾	Linseed	2	11¼
English linseed cake ..	2	2	English maple peas ..	2	11½
Malt culms	2	3½	Maize meal	3	0½
Wheat sharps	2	4½	Bombay cotton cake ..	3	0¾
Wheat bran	2	5½	English oats	3	2¼
English beans	2	5½	Linseed oil	3	5¾
Wheat bran (broad) ..	2	6¾	English feeding barley ..	3	7¾
Argentine maize	2	7¾			

TABLE V.

PRICES PER FOOD UNIT. BRISTOL.

	s.	d.		s.	d.
Ground-nut cake ..	1	7¾	English beans	2	6½
Maize gluten feed ..	2	0¾	Maize germ meal ..	2	6½
Palm-nut kernel cake ..	2	2¼	Argentine maize ..	2	7¾
Brewers' grains (dried) ..	2	3	Egyptian rice meal ..	2	9
English linseed cake ..	2	3¼	Egyptian cotton cake ..	2	11½
Malt culms	2	4	Maize meal	2	11½
Wheat bran	2	4¼	English feeding barley ..	3	0½
Wheat sharps	2	4½	English oats	3	1¼
Wheat bran (broad) ..	2	5	Argentine oats	3	2¼
Wheat middlings ..	2	5	Linseed oil	3	11¾

TABLE VI.

AVERAGE PRICES PER FOOD UNIT.

	s.	d.		s.	d.
Brewers' grains (wet) ..	1	4¼	Argentine maize ..	2	7½
Ground-nut cake ..	1	7¼	Egyptian cotton seed ..	2	7½
Soya bean cake	1	11	American maize.. ..	2	8¾
Maize gluten feed ..	1	11¼	English dun peas ..	2	9
Decorticated cotton cake	2	0¾	Burmese rice meal ..	2	10¼
Coconut cake	2	1	Egyptian cotton cake ..	2	10½
Indian linseed cake ..	2	1¼	Egyptian rice meal ..	2	11¼
Palm-nut kernel cake ..	2	1¼	English maple peas ..	2	11¼
Brewers' grains (dried) ..	2	1½	Linseed	3	0¼
Chinese beans	2	1¾	Maize meal	3	0½
English linseed cake ..	2	2¾	Bombay cotton cake ..	3	1½
Wheat middlings ..	2	3	Argentine oats	3	2¼
Wheat pollards	2	3¼	English oats	3	2¼
Wheat sharps	2	4¾	English feeding barley ..	3	4
Wheat bran	2	5	Feeding treacle	3	5½
Malt culms	2	5	Calcutta white peas ..	3	6¼
Wheat bran (broad) ..	2	6	Linseed oil	3	8½
Maize germ meal ..	2	6¼	Cotton seed oil	4	4¾
English beans	2	6½			

TABLE VII.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Name of Feeding Stuff.	Nutritive Ratio.	Per cent. digestible.			Starch equiv. per 100 lb.	Linseed Cake equiv. per 100 lb.
		Protein.	Fat.	Carbo-hydrates and Fibre.		
Foods Rich in both Protein and Oil or Fat.						
Ground-nut cake	1 : 0·8	45·2	6·3	21·1	77·5	102
Soya bean cake	1 : 1·1	34·0	6·5	21·0	66·7	88
Decort. cotton cake ..	1 : 1·2	34·0	8·5	20·0	71·0	93
Linseed cake, Indian ..	1 : 1·9	27·8	9·3	30·1	77·1	101
Linseed cake, English ..	1 : 2·0	26·7	9·3	30·1	76·0	100
Cotton cake, Egyptian ..	1 : 2·1	15·5	5·3	20·0	40·0	53
Cotton cake, Bombay ..	1 : 2·5	13·1	4·4	21·5	37·6	49
Maize gluten feed	1 : 3·0	20·4	8·8	48·4	87·4	115
Brewers' grains, dried ..	1 : 3·5	14·1	6·6	32·7	50·3	66
Coconut cake	1 : 3·8	16·3	8·2	41·4	76·5	101
Palm-nut kernel cake ..	1 : 4·6	12·5	7·7	39·0	69·5	90
Linseed	1 : 5·9	18·1	34·7	20·1	119·2	157
Fairly Rich in Protein, Rich in Oil.						
Maize germ meal	1 : 8·5	9·0	6·2	61·2	81·0	107
Rice meal	1 : 9·4	6·8	10·2	38·2	68·4	90
Rich in Protein, Poor in Oil.						
Peas, Calcutta white ..	1 : 2·1	23·3	1·1	45·9	66·9	88
Beans, English	1 : 2·6	19·3	1·2	48·2	67·0	88
Beans, Chinese	1 : 2·6	19·6	1·7	47·9	67·0	88
Peas, English maple ..	1 : 3·1	17·0	1·0	50·0	70·0	92
Brewers' grains, wet ..	1 : 3·5	3·5	1·5	8·6	12·7	17
Malt culms	1 : 3·6	11·4	1·1	38·6	38·7	51
Cereals, Rich in Starch, not Rich in Protein or Oil.						
Barley, feeding	1 : 8·0	8·0	2·1	57·8	67·9	89
Oats, English	1 : 8·0	7·2	4·0	47·4	59·7	79
Oats Argentine	1 : 8·0	7·2	4·0	47·4	59·7	79
Maize, American	1 : 11·5	6·7	4·5	65·8	81·0	107
Maize, Argentine	1 : 11·3	6·8	4·5	65·8	83·5	110
Maize meal	1 : 13·0	5·5	3·5	63·9	77·8	102
Wheat middlings	1 : 5·3	12·0	3·0	56·0	59·1	78
Wheat sharps	1 : 5·0	12·0	4·0	50·0	58·4	77
Wheat pollards	1 : 5·3	11·6	3·5	53·0	54·1	71
Wheat bran	1 : 4·7	11·3	3·0	45·0	49·7	65
Wheat bran, broad ..	1 : 4·7	11·2	3·0	45·4	48·1	63

For Bullocks.—Linseed cake and bean meal are not much dearer per food unit at the present time than other foods, and it would not entail much extra cost to replace part of the concentrated ration by 2 lb. of these well-tried foods in order to put a finish on bullocks nearly ready for the butcher. For less forward bullocks the rations recommended last month are not likely to be improved upon at the moment.

Where it is necessary to limit the root ration to not more than about 56 lb., ground nut cake is too concentrated to use alone. The cheapest starchy food to mix with it is probably tail corn, where this is available. These foods should be mixed in equal proportions, and used at the rate of about 7 or 8 lb. per head per day.

Ewes with Lambs on Grass.—Ewes under these conditions will probably get a few mangolds, and are likely to show signs of scouring. The cheapest concentrated food to give them at present prices in order to keep their digestive organs in a healthy condition is 1 lb. per head per day of beans or peas.

Rations for other Stock as last Month.

Notes on Manures in March: *From the Rothamsted Experimental Station.*

THE rain and snow towards the end of February had the effect of bringing heavy soils into a sticky condition, and this effectually prevents the water from getting away and may injure the winter corn. Soils that have been well chalked or limed are less likely to suffer than others, and farmers on the red, flinty clay overlying the chalk in Kent, Surrey, Hants, Bucks, Herts, etc., will do well to note the fields that get into this state with a view to chalking or liming next autumn, if it then proves at all possible to do it. Further, such land should be subsoiled, if possible, when next it comes under roots or potatoes. Until the water has been got away it will be of little use to apply top-dressings.

It has been ascertained at Rothamsted that the loss of nitrate from the soil during the past winter has been considerable. This has to be made good, and this year the need of spring manuring is greater than usual. Farmers who have not yet top-dressed their wheat or winter oats should do so without delay.

Prices of Manures.—As compared with last month prices continue to rise, except in the case of 93 per cent. sulphate of ammonia, which shows a fall. Nitrolim and nitrate of lime are both higher in price, although where they can be obtained they still remain the cheapest of the quick-acting nitrogenous manures. Other manures are also rising, and farmers who bought early are reaping the advantage of their action. For the time being, however, farmers are not restricted to the quick-acting manures. It is not too late to use organic manures, provided they are easily available, in fine condition, and are worked into the soil. Attention may here be directed to whale guano, an organic manure now obtainable, which has not hitherto been much used in this country; although a British product it has been shipped to the Continent and America. It contains from 8 to 10 per cent. of ammonia and 20 to 30 per cent. of phosphates: it resembles fish guano in a general way, but contains a fair amount of oil—about 17 per cent. There is a widespread opinion that

oil is injurious to manure, but little direct evidence in support of the view: on the other hand oil has no manurial value and would only be wasted in the soil even if it proved harmless. Samples of the above composition would, at present prices of other manures, be worth about £8 to £10 per ton: they could be used for roots, potatoes and special crops, such as hops, etc.

Schemes of Manuring for Crops.—The farmer should by now be in a position to draw up his scheme for manuring. The main point to bear in mind is the imperative need of getting as much produce as possible out of the land.

Wheat.—This crop responds well to kindly treatment, and, under present conditions, liberal manuring is most emphatically desirable. There are two common cases, one being that in which the land involved can produce 40 bush., but commonly only yields 30 bush. or less. A good deal of land of this description is found on the boulder clay of the Midlands, and the flinty clay of the Home Counties. In days gone by some of it was accounted good wheat land, but years of low prices have caused the crop to lose its former position. The most satisfactory manure for wheat on this land is farmyard manure, but this cannot usually be spared, and in any case it could not go on now. The next best thing is to give a suitable dressing of artificials. For the heavier soils it is, in most seasons, desirable to apply phosphates, and this year the need is increased by the wetness of December and February: the phosphates help in root development and enable the plant to start growth early. A suitable dressing is 2 to 4 cwt. of superphosphate (the smaller dressing for rather dry conditions, the larger one for wet conditions), and 1 to 2 cwt. of nitrate of soda or sulphate of ammonia, or, if the tilth is bad, 30 bush. of soot. The larger dressings must be given in two applications and not all at once.

These dressings are heavy: in peace times they might be considered too heavy to give any profitable return, but the special conditions justify high manuring.

In Rothamsted experiments the increases shown in the table on p. 1283 have been obtained by the use of top-dressings of sulphate of ammonia and nitrate of soda. The years given in the table are chosen because the rainfall conditions were similar to those of the present season, the rainfall, 1st October—10th February, having been 13·7 in.

On lighter soils there is less need for phosphates, and none need be given if the preceding crop was roots or potatoes receiving 3 or 4 cwt. of superphosphate or bone meal. If no phosphates

have been applied for 2 or 3 seasons it is desirable to give 2 cwt. of superphosphate.

One to 2 cwt. of sulphate of ammonia or nitrate of soda should also be given, and, if the land is likely to scorch, or if kainit is known to be beneficial, 2 cwt. of salt would probably prove beneficial.

In districts of low rainfall, however, these dressings may not prove remunerative. Farmyard manure is probably the best manure under the circumstances.

In regard to soils that normally produce 40 to 50 bush. of wheat no general advice can be given. On the land of the brick-earth type, producing large heads well set with corn and borne on

BROADBALK WHEAT.—*Bushels of Grain per Acre.*

Year of Crop.	Rainfall: Inches, 1st Oct. to 10th Feb.	Minerals alone.	Minerals and Ammonium Salts.	Minerals and Double Ammonium Salts.	Minerals and Treble Ammonium Salts.	Minerals and Nitrate.	Minerals and Double Nitrate.
		Plot 5.	Plot 6.	Plot 7.	Plot 8.	Plot 9.	Plot 16.
1897	14·1	12·8	19·4	28·6	36·9	25·8	27·5
1900	13·2	12·8	19·3	29·8	44·0	23·7	34·9
1907	13·9	11·5	23·9	33·6	34·7	30·2	34·7
1911	13·6	14·8	17·1	25·6	36·4	29·9	40·4
Average increase per acre due to Nitrogen.		—	7·0	16·4	25·0	14·4	21·4

stiff straw, it may be safe to try and increase the yield by means of a dressing of 1 cwt. of sulphate of ammonia or nitrate of soda. On lighter soils that were heavily sheeped last year there might, however, be risk of having the crop laid.

If a second wheat crop is being taken, the following manurial ingredients in lb. per acre would return to the soil all that is removed.

	Nitrogen. lb.	Phosphate as Phosphoric Acid. lb.	Phosphate as Tricalcic Phosphate. lb.	Potash. lb.
Grain only sold:				
30 bushel crop	34	14	31	9
40 „	46	19	42	12
Grain and Straw sold:				
30 bushel crop	50	21	46	29
40 „	67	28	62	39

The spring dressings suggested above would supply all the phosphate and much of the nitrogen required, and sufficient potash would usually be contained in the dung applied to the following root crop to maintain the fertility of the soil.

Oats.—Oats, like wheat, respond well to liberal treatment. They require an all-round dressing, and, as a result of various trials, the following is usually recommended:—2 to 3 cwt. of basic slag or superphosphate, and 2 cwt. of kainit, worked in with the seed, and 1 to 1¼ cwt. of nitrate of soda or sulphate of ammonia applied later on. The need for kainit is reduced by dressings of dung, but if no dung was applied in autumn, and if kainit is known to be essential, then 2 cwt. of salt may be substituted.

Basic slag is less generally useful than superphosphate for spring oats, but it answers on naturally wet land, such as some of the moorlands in the West of Scotland.

"*Seeds.*"—Careful inspection of the "seeds" should now be made, and if it appears that the clover has suffered badly through the wet winter, and is obviously not going to do well, an effort should be made to obtain a good growth of the grass. This can be done by applying 1½ to 2 cwt. of nitrate of soda or sulphate of ammonia. If liquid manure is available it might be used instead, unless it is all wanted for the permanent grass land.

Unit Prices of Artificial Manures in March.—The statement on p. 1285 shows the cost to the purchaser of 1 per cent. per ton of nitrogen, and soluble and insoluble phosphates derived from various sources, at certain ports and manufacturing centres, for March, 1916.

NOTE.—These unit prices are based on the *probable* retail cash prices in bags f.o.r. for quantities of not less than 2 tons of the manures mentioned at the ports and places specified, but it should be borne in mind that market prices are fluctuating considerably at the present time. The prices are published by the Board of Agriculture and Fisheries for use in comparing the commercial values of artificial manures. They may also be used as a guide to the probable price per ton of any of the manures mentioned if the unit prices of the constituents of the manure are multiplied by the percentages of the constituents found in it, and due allowance is made for the difference between cash prices and credit prices, and for cost of carriage from the nearest centre to the place where it is delivered to the purchaser. If used in connection with the valuation of a compound manure regard must be had to the sources of the constituents, and a reasonable sum must be added for mixing, disintegrating and rebagging the ingredients, bags, and loss of weight.

	London.	King's Lynn.	Hull.	Newcastle.	Silloth.	Liverpool.	Widnes.	Newport.	Bristol.	Plymouth.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Nitrogen from:										
Sulphate of Ammonia pure.. 95%	—	17 0	16 6½	16 9	—	—	—	17 6	—	—
Sulphate of Ammonia pure.. 93%	—	—	—	—	—	17 5½	17 5½	—	17 3½	17 8½
Calcium Cyanamide ..	—	—	15 6	16 1½	—	—	—	—	—	17 9
Nitrate of Soda pure 95%	—	22 1	22 3	—	—	22 3½	22 9	—	22 11	—
Nitrate of Soda pure .. 90%	23 8	—	22 8	—	—	—	—	24 4	23 8	23 4
Nitrate of Lime ..	—	—	16 0	—	—	—	—	—	—	—
Soluble Phosphates from:										
Superphosphate 35%	2 8½	—	2 8½	3 0	—	2 9½	2 8½	2 9½	2 9½	2 9½
,, 33%	2 8½	—	2 9½	3 0½	—	2 9½	2 8½	2 9½	2 9½	2 9½
,, 30%	2 9½	—	2 10½	3 2	—	2 10½	2 9½	2 10½	2 10½	2 10½
,, 26%	3 1	2 8½	3 1	3 6	—	3 2	3 1	3 2	3 2	3 2
Dissolved Bones.. ..	3 10½	—	4 0	—	—	4 2½	4 0½	3 11½	4 1	3 10½
Allowed for Nitrogen	*21 2*	—	*21 10*	—	—	*23 0½*	*22 3½*	*21 8*	*22 4½*	*21 4*
Allowed for Insol. Phos.	*2 1½*	—	*2 2½*	—	—	*2 4*	*2 3*	*2 2½*	*2 3*	*2 2*
Insoluble Phosphates (Citric Soluble) from:										
Basic Slag	2 7½	—	2 3	—	—	2 0½	—	—	2 1	—
Insoluble Phosphates from:										
Basic Slag	—	—	1 10½	1 8	—	1 9	—	—	—	—
Bone Meal	1 11	1 10½	2 0	1 11½	—	2 0½	2 0½	1 8½	1 9½	1 11½
Allowed for Nitrogen	*19 0*	*18 5*	*19 7½*	*19 1*	—	*20 1½*	*20 2½*	*16 8½*	*17 8*	*19 2*
Steamed Bone Flour..	1 11½	—	2 0½	—	—	—	—	1 9	1 11½	—
Allowed for Nitrogen	*19 5*	—	*20 2½*	—	—	—	—	*17 0½*	*19 3½*	—
Potash					No quotations.					

The Soya Bean.

THE Soya Bean (*Glycine hispida*) is a sub-erect or creeping leguminous plant, somewhat resembling the "French Bean" in appearance and habit of growth. It is a native of Eastern Asia, and has been grown for a long period in China and Japan, where the bean is used for human consumption, its high content of albuminoids and oil making it particularly valuable as a supplement to starchy foods such as rice.

The soya bean, which is a round, yellowish seed about the size of a field pea, was not imported in any considerable quantity into this country before 1908. It is, itself, used here to some extent as a cattle food, but as a rule the greater part of the oil is first removed by seed crushers, the residual cake or meal being used for feeding purposes. The following are analyses of the soya bean and of soya bean cake, in comparison with the English bean and decorticated cotton cake.

	Soya Bean.	*English Bean.*	*Soya Bean Cake.*	*Decort. Cotton Cake.*
Albuminoids ..	36	25	43	41
Oil	17	1½	6	9
Carbohydrates..	26	48	28	26
Fibre	5	7	5	8

Experiments with soya bean cake tend to show that, when fed in moderation, it is a useful feeding stuff; otherwise it is apt to prove distinctly laxative. For this reason it is usually given along with undecorticated cotton cake. At present prices it is one of the cheapest feeding stuffs on the market. See also p. 1277 of this *Journal*.)

The following table gives the imports of soya beans, and their value in respect of the years ending 31st December, 1912, 1913, 1914 and 1915:—

Quantities in tons.

1912.	1913.	1914.	1915.
188,760	76,452	71,161	175,136

Value in £ sterling.

1912.	1913.	1914.	1915.
1,567,960	635,747	593,190	1,461,525

Few of our home-grown foodstuffs approach the soya bean in value. and it is clear that if it could be grown successfully in this country, it would soon find a place in ordinary farm practice.

Previous to 1909 a few attempts had been made to grow the crop in England, but without any success; at best, the plants grew up to flowering stage but formed no seed. About this

time, with the object of securing the hardiest sorts in cultivation, the Board obtained from an experiment station in North Japan, seed of 16 varieties, together with a small quantity of soil in which the crop had been grown. These were sown at the Midland Agricultural and Dairy College and on the Cambridge University Farm. At both centres the results were similar—many of the varieties grew well, but none formed flowers. Where the Japanese soil had been applied the nodule formation was all that could be desired, but where no inoculation had taken place, no nodules were formed.

In 1910 the Board obtained seed of several varieties from Manchuria. These were grown at the same centres as before. At the Midland College the crop grew vigorously, but formed no seed, while at Cambridge the plants ripened a small quantity of seed. This seed was sown in 1911, but the crop made little growth, and in spite of the hot season no seed was produced.

These results prove conclusively that the Japanese and Manchurian varieties hitherto tested cannot be relied upon to produce seed in this country. As the plant appears to be a very variable one, however, it is not impossible that a variety suited to conditions in this country may yet be produced.

In some experiments at Wye College, Kent, with seed supplied by the Macdonald College, Quebec, well-filled pods were produced in 1910, from a varicty known as "Early Tennessee," when the soil was inoculated.

Apart from seed production the plant might have some value in this country as a forage crop. It appears to resist drought well, and is largely grown in the United States for green fodder, which appears to be liked by all classes of farm stock. In general composition the green plant resembles clover.

In America the early varieties mature in the northern part of the corn belt, but frequently do not yield sufficiently to warrant growing them for seed. Farther south, however, they can be profitably cultivated for seed. Generally speaking, the soya bean requires about the same temperature as maize.

THE following note has been communicated to the Board by Mr. B. P. Davis, F.T.C.:—

The Use of Granular Nitrolim.*

Granular nitrolim differs materially from nitrate of soda, and in some respects from sulphate of ammonia.

Generally speaking, it may be observed that nitrolim gives

* A summary of some recent experiments with granular nitrolim will be found on pp. 1296 and 1301

best results when harrowed into the soil, and this, together with early application, is a point to be remembered. There is no fear of its being washed out of the soil, and hence, if applied early, not only will the nitrogenous compound have an opportunity of becoming thoroughly incorporated in the soil, but the free lime which it supplies (40 per cent.) will also be able to exert its beneficial action.

As a top dressing for winter wheat nitrolim should be applied (1 to 1½ cwt. per acre) in early spring, preferably just before the first harrowing of the wheat; for grass land (hay), from the last week of February to the middle of March is the most suitable time.

For spring-grown cereals (1 to 1½ cwt.) and root crops (2 cwt.) nitrolim should be broadcasted just before, or at time of sowing, and for potatoes, it may be mixed with superphosphate (and potash when available) and broadcasted over the drills before the tubers are planted and the ridges split back. It is not advisable to apply it as a top dressing to mangolds, and for cabbage (2 cwt.) it should be applied between the rows and not over the plants.

With regard to mixing with other fertilisers, the following points may be noted:—

Nitrolim makes an excellent mixture with basic slag, no chemical changes taking place at all; it mixes equally readily with bone meal, steamed bone flour, potash salts and common salt. It is not recommended, however, that a mixture of nitrolim and salt should be stored for any length of time; it is better to mix them only a reasonable time before application. Nitrolim must not be mixed with sulphate of ammonia, but mixes well with nitrate of soda. Its behaviour with superphospate depends to a certain extent on the proportions used and the condition of the superphosphate. In proportions of, say, one of nitrolim to four of superphosphate, where the latter is in good dry condition, an excellent texture is obtained, with very little (if any) development of heat and certainly no loss of ammonia. In equal proportions with damp superphosphate, considerable heat may be developed and steam may be given off, but even then it is unlikely that any loss of ammonia would occur. A certain amount of reversion may take place, but the reverted phosphate is still citric soluble and available as plant food. It is recommended that, where convenient, the mixture should be made just before application, especially when a higher proportion of nitrolim than one to four is being employed.

Calcium Carbide Residue for Liming.

THE residue left after acetylene gas has been made from calcium carbide consists substantially of calcium hydrate, *i.e.*, slaked lime, containing from 30 to 40 per cent. of water. The dry matter contains 60 per cent. or more of CaO (as compared with 80 to 90 per cent. in the case of a good quicklime).*

The impurities usually found in calcium carbide are small quantities of silicon, sulphur, iron, phosphorus and carbon, but not such as will render the residues generally unsuitable for agricultural purposes if proper care is taken.

A sample of *fresh* calcium carbide residue recently examined at the Government laboratory was found to contain small quantities of calcium sulphide and calcium sulphocyanide, but no other substance likely to be poisonous to plant life was detected. In a *weathered* sample of the same residue only a faint trace of calcium sulphide was found, indicating that exposure rapidly oxidises the sulphide; and only 0·001 per cent. of calcium sulphocyanide was found, it being probable that, since the latter is soluble in water, the rain washed out the greater portion of this substance during exposure. The residues from generators are usually put into heaps, but it should not be assumed that such heaps become weathered. If little or no attempt is made at aeration, the great bulk of the sulphide probably remains unoxidised after the lapse of a considerable time owing to the caking of the hydrate on the outside of the heap.

On weathering, the calcium hydrate would, to some extent, probably be converted into carbonate, but the carbonate would be in a finely divided condition and readily decomposed by soil acids. Its action would, therefore, differ only slightly from that of hydrated lime.

In substituting calcium carbide residue for lime it is recommended, therefore, that the use of *fresh* carbide residue should in all circumstances be avoided.

After exposure to the weather, the carbide residue is best applied to fallow ground during the winter; trials on a small scale should be made before any growing crop is dressed with the residue.

The carbide residue may be applied in the same quantities (when dry) as ordinary quicklime. It should not be mixed with farmyard manure, or loss of ammonia from the latter will result; indeed, it should be put on the field a few months before the farmyard manure.

* In a note in this *Journal* for October, 1915, p. 699, it was stated inadvertently that "the dry matter contains about 60 per cent. of quicklime, *i.e.*, *about* 50 *per cent. of CaO*." The words in italics should not have appeared

IN the article on seed testing which appeared in this *Journal* for February, 1916, p. 1055, reference to the work done at Aberystwyth was inadvertently omitted.

Seed Testing at Aberystwyth.

The testing of farm seeds at Aberystwyth has been conducted in conjunction with endeavours to arouse amongst farmers a greater interest in the care of grass land generally. The most hopeful sign for the future is felt to be the fact that an increasing number of farmers' co-operative societies seek advice from the College in the matter of purchasing their seeds. Two societies regularly send their samples to be tested, whilst four local societies have sought advice as to the mixtures most suitable to the needs of their members. This season three local merchants have already sent samples to be tested, whilst two have made inquiries to the mixtures most suitable to the needs of their clients.

It must be pointed out that many of the co-operative societies in the College area have long realised the importance of good seed and well-balanced mixtures, and that the early pioneer work of such societies has been of great value. Many local merchants have also done much to persuade farmers to purchase seeds of high quality. There is, however, still room for very great improvement, especially in certain localities.

There are fully adequate facilities for seed testing at Aberystwyth, the work being undertaken by Mr. R. G. Stapledon, M.A., Agricultural Department, University College of Wales, Aberystwyth. Samples should be sent to Mr. Stapledon, or to the Agricultural Organiser for the several counties covered by the College (Brecon, Cardigan, Carmarthen, Merioneth, Montgomery, Pembroke, Glamorgan, Monmouth, and Radnor).

No charge is made to farmers in the College area, but 1*s.* per sample is payable by co-operative societies and merchants resident in the area. A complete report includes the percentages of purity, germination and real value; particulars as to weed seeds and "hard" seeds are also given, and, when desirable, also as to the probable age of the sample.

A special endeavour was made to collect samples in 1913, and 370 samples were examined; 205 samples were examined in 1914, and 270 samples in 1915.

The benefits are beginning to be apparent in the district, the most noticeable feature being the greater care taken by many

farmers in the purchase of cocksfoot, and home-grown clovers in particular. There is also a tendency to discontinue the use of rye grasses of very low bushel weight.

THE Board have recently sent the following memorandum to a correspondent in reply to an inquiry as to grazing in common:—

Grazing in Common.

1. There are many tracts of land in England where the ownership of the soil is held by one person subject to certain pasture-rights, possessed by other persons called commoners, which rights are exercisable in some cases throughout the year, and in other cases after the crops are taken. These pasture-rights are in some cases attached to a particular farm or tenement, and measured by the number of beasts which the commoner is able to keep on his own farm or tenement in the winter by the produce raised on the farm during the summer; but in many other cases the pasture rights are fixed or "stinted" to a specified number, and are in such cases capable of being bought and sold apart from the farm or tenement to which they originally belonged.

2. As to the "rules and regulations" governing such common land, these are in most cases in England made on a voluntary basis by the persons concerned, without the cognisance of any local or central administrative body, and deal—as far as the Board are aware—with arrangements, suited to the particular local conditions, prescribing the kind of animals that may be turned out on the common pasture and the times at which they may be so turned out, etc. In a small number of cases, the owner of the soil and the commoners have voluntarily applied to the Board to adjust their rights, under the provisions of the Commons Act, 1876; but there is no compulsion by the State in the public interest on them to have the rights adjusted, which probably in many cases remain in a confused and obscure condition. The number of applications to the Board under that Act has decreased; less than 50,000 acres have been regulated under it as contrasted with the 2,000,000 acres assumed by a House of Commons Select Committee in 1913 (H.C.R. 85 of 1913), to represent the common or waste land in England and Wales. As a specimen of by-laws confirmed under that Act by a central administrative body, the Burrington by-laws of 11th May last, affecting about 1,000 acres in the County of

3. In the Small Holdings and Allotments Act, 1908, provision has been made for the creation of common pasture, but up to the present time this provision has not been used to any considerable extent.

Sale of Cows with Milk Recording Certificates.

THE Board have received a report of a sale of farming stock belonging to Mr. John Gifford, Middle Farm, Tarlington, Somerset. The special interest of the sale is the fact that it is the first in which the Milk Records Certificates issued by the Board were referred to by the Auctioneer and handed by him at the sale to purchasers. The cows are reported to have made from £2 to £4 per head more than they would have done had they been sold without certificates, and the vendor is satisfied that the possession of the certificates for the cows resulted directly in a net increase in the total prices obtained of approximately £200. Mr. Gifford is a member of the North Cadbury Milk Recording Society, which was the first to start operations under the Board's Milk Recording Scheme, and the result of his sale shows that a Milk Recording Certificate as issued by the Board has a commercial value. These certificates are only issued after the Board have satisfied themselves that the records of milk yields have been kept in accordance with their Regulations, which provide for supervision and independent checking. The Board hope that when the commercial value of their certificates is generally realised, a considerable stimulus will be given to Milk Recording throughout the country.

Reduction in Bare Fallows.

A BARE fallow can never be a directly profitable operation and has no justification on free-working land. But with strong clays in dry climates, as for example over much of the East and South-East of England, a bare fallow may sometimes be necessary to clean the land and restore its friable texture; on such soils also there is least likelihood of loss through the washing out of the reserves of nitrogen which have been rendered available by the process. Bare fallowing may in such a case be useful.

Under present conditions, however, bare fallowing should be reduced to the narrowest possible limits. At a low estimate a bare fallow will cost about £2 per acre for cultivations alone, to say nothing of rent, rates, taxes and, possibly, manure as well; and this assumes that enough labour will be available to make a

success of the process. It is not sufficient merely to plough or cultivate a certain number of times: each operation must be done when the conditions are most favourable for the objects in view. All things considered, therefore, it would be well, so long at least as the war lasts, to adopt bare fallowing only as a last resource and, where the land has become very foul or exhausted, to try the effect of a bastard fallow. A quick-growing crop, such as white mustard or rape, might be sown for consumption on the land by sheep receiving cake; or a smother crop, such as vetches, might be grown for soiling, ensilage, or making into hay. As soon as possible after the removal of such crops the land should be broken up and exposed to the weather in preparation for autumn corn. If such catch crops are well manured with nitrogenous and phosphatic fertilisers the labour and expense of autumn cleaning will not, as a rule, be great.

Hatching of Chickens.

As the home supply of eggs for next winter depends to a great extent on the hatching results of the next few weeks, it is very important that preparations should be made for hatching and rearing as large a number of useful chickens as possible. During the present season the poultry-keeper should endeavour to secure chickens from strains which will improve the quality of his present stock; he should prepare to increase the stock where this is practicable, and special attention should be devoted to the management of the chickens. The cost of rearing the birds is higher than usual, but the return for the produce has also been higher than in normal times, and there is a reasonable prospect of a steady demand at prices which are likely to prove satisfactory. Poultry-keepers should exercise economy, not by reducing their output, but by producing a better quality of chicken so that for the same expenditure on food they may obtain a higher return in produce.

During the rearing season a strict system of selection should be practised, and all weakly and unsuitable birds should be killed so as to reduce unnecessary expenditure on food and labour. The production of larger numbers of chickens of good quality during the present hatching and rearing season may be commended to poultry-keepers as a form of service which is likely to prove of value. In this connection reference may be made to Leaflet No. 305 (*Selection of Poultry for Breeding Stock and the Hatching of Chickens*) and Special Leaflet No. 54 (*The Rearing of Chickens*), copies of which may be obtained free on application.

Agriculture and Live Stock in Brazil.

IN a book* recently published, dealing with Brazilian problems, it is urged that the prosperity of Brazil in the future can best be assured by making the collection and preparation of rubber in the Amazon basin for export subsidiary to agriculture, stock raising, and other industries, and not the main, and, in fact, the sole industry that it can well claim to be at present. It is pointed out that rubber is no longer a commodity of which Brazil holds a monopoly, and the same is true to a certain extent of cacao, grown in regions further south than the Amazon.

Brazil possesses large areas of cheap and productive lands which are not at present utilised, while, on the other hand, the increasing demand for food stuffs is instrumental in maintaining a high cost of living. The great cost of producing rubber is largely due to the high price of meat, fresh meat (except that which comes from the forest) being unobtainable in the rubber districts. It is, therefore, suggested that the course to which Brazil will be forced will be to ditch, drain, break up, and cultivate the flat, open lands in the rubber zone, and to clear and drain the forest areas. The agricultural resources would be best developed by hard-working settlers, rooted to the soil as owners of small homesteads, and who would augment the income so obtained with the profits from rubber gathering. For this purpose it is stated that immigrants will have to be encouraged, whether Indian, Negro, Japanese, or Chinese.

Further, to keep her grip on the world's demand for her products, especially rubber, Brazil must have a much larger population, but this again points to the need for first increasing the amount of home-grown food stuffs; with larger supplies of meat and milk (which are an important adjunct to the food even of the labouring classes) the infant mortality will be reduced, and healthy, strong, and vigorous families reared.

The possibility is alluded to of the eventual establishment of an export trade in meat products, especially of pig products from the Amazon, but what is wanted at present is an increased meat supply for the local population. Various tropical crops are recommended for the proposed small holdings on the Amazon, and the produce (*e.g.*, ground nuts, maize, lucerne) would be used in part to supplement food stuffs for animals.

It is recognised that the work of developing a dairy or cattle-breeding industry in the Amazon will be an uphill task; to evolve a sound, remunerative industry spread over a large area is a big undertaking, even with pasture land, etc., ready to receive the animals; whilst to prepare the land and discover the food supplies for the cattle around many of the settlements attached to the *estradas* is thought to be impossible at present, although it is hoped that this will not always be the case.

The volume also contains particulars relating to live stock in Brazil, and the introduction of various foreign breeds of cattle. Information on the subject has been published in this *Journal* on several occasions,† mainly with a view to indicate the demand which exists, and the

* The Rubber Industry of the Amazon, and How its Supremacy can be Maintained, *J. F. Woodroffe* and *Harold Hamel Smith*. London: John Bale, Sons and Danielsson, Ltd., 1915.

† See this Journal for March, 1915 (p. 1079); May, 1913 (p. 167); November, 1911 (p. 695); December, 1910 (p. 766); March, 1910 (p. 1016).

prospect of increasing the export of British pedigree animals to that country. The following additional details are taken from a recently issued official publication* :—

The Federal Ministry of Agriculture, as well as private breeders, have shown a marked interest in the question of the improvement of the native stock through the admixture of foreign blood. Brazil may be said to have three different climatic zones, and great difficulty has been experienced in selecting the foreign breeds suitable to these various zones. The greatest difficulty has been the stamping out of the red-water fever, which on some ranches attacked 80 per cent. of the cattle and frustrated the first attempts to import foreign cattle. The zootechnical station at Pinheiro is paying especial attention to this question, and claims that fatal cases of fever in their station do not exceed 7 per cent. Although a certain amount of British stock is mported, there seems to be a preference in favour of Limousin, Swiss, and Dutch breeds as being better able to resist red-water fever.

The central zootechnical station of the Republic is at Pinheiro, whence selected breeds are distributed to the minor stations in São Paulo, and Minas Geraes, as well as to individual breeders who prefer to take advantage of the import bounties offered them. Two other stations now exist at Lages, in Santa Catharina, and at Ribeirao Preto, in São Paulo.

Four model farms are being set up at Santa Monica in the State of Rio de Janeiro, Ponta Grossa in Parana, Uberaba in Minas, and at Caxias in Maranhão. The Santa Monica farm has already 6c5 head of cattle and horses, and at Ponta Grossa there are a number of Southdown sheep.

Subsidies are granted by the Federal Government to importers of certain European animals. including horses, asses, swine, sheep and goats; but no importer can receive bounties on more than 10 head annually. In order to receive the grants, the importer has to obtain approval of the breeds selected, and the animals must be in perfect health, and accompanied by pedigree and veterinary certificates. The documents must be legalised at a Brazilian Consulate in the country of origin, and must be accompanied by two photographs of each animal.

The Brazil Land, Cattle and Packing Company, which is affiliated to the Brazil Railway Company, imported in 1912 a large herd of Shorthorns and Herefords from Texas, United States of America. The experiment is reported to have been highly successful, and comparatively few of the cattle contracted red-water fever. Those of the cattle imported from the non-fever districts of the United States did not escape the fever, but the majority recovered.

Exportation of Live Stock to Russia.

The Russian Government have recently adopted new regulations which require that live stock imported from the United Kingdom must be accompanied by an official certificate testifying that during the preceding six weeks the districts from which the animals are exported have been free from the following contagious diseases, viz.: anthrax, glanders, and farcy, in respect of horses; anthrax, cattle-plague, foot-and-mouth

* Foreign Office Report on the Trade of Brazil, Annual Series, No. 5451.

disease, and pleuro-pneumonia, in respect of cattle; anthrax, foot-and-mouth disease, and sheep-pox, in respect of sheep and goats; and anthrax, foot-and-mouth disease, and swine-fever, in respect of pigs.

In order to obtain the official certificate, intending exporters of live stock from Great Britain must apply to the Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W., for forms of application, which should be returned, duly completed, and accompanied by a certificate, signed by a duly qualified veterinary surgeon, testifying that the animals are in good health, and free from contagious or infectious disease; and that the premises from which the animals are exported have been free from infection during the previous six weeks. These certificates will not require Consular endorsement.

In the case of cattle, a separate certificate is required, indicating that each animal has successfully passed the tuberculin test. This document must be endorsed by a Russian Consular Officer.

Official certificates for live stock exported from Ireland, whether the animals are sent direct or transhipped in Great Britain, are issued by the Secretary, Department of Agriculture and Technical Instruction for Ireland (Veterinary Branch), 50 & 51, Upper Mount Street, Dublin.

Live stock exported to Russia from other countries (*e.g.*, the Channel Islands) through the United Kingdom must be accompanied by an official certificate from the Authorities of the country of origin, as regards the non-existence of disease in the districts from which the animals come; and a certificate of health signed by a local Government Veterinary Surgeon. A tuberculin certificate is also required in the case of cattle; and all these documents must be endorsed by a Russian Consular Officer.

The exportation of live stock from the United Kingdom is at present prohibited by Order in Council, but applications for export licences may be made to the War Trade Department, 4, Central Buildings, Westminster, S.W.

SUMMARY OF AGRICULTURAL EXPERIMENTS.*

SOILS AND MANURES.

Granular Nitrolim and Nitrate of Lime.—(*Midland Agric. and Dairy Coll. Rept. on Field Trials*, 1915).—The following remarks are made in the Report as to these manures:—

"Granular nitrolim is a new form of nitrolim put on the British market in 1914 for the first time. It is a dry, granular material, not nearly so dusty as the original nitrolim, and consequently much easier and pleasanter to handle. Our trials have shown that it is unaffected by the atmosphere, that it can be safely mixed with superphosphate without the mixture becoming hot, that it forms a dry, friable mixture

* A summary of reports on agricultural experiments and investigations is usually given in the *Journal*. The Board are anxious to obtain for inclusion copies of reports on inquiries, whether carried out by agricultural colleges, societies, or private persons.

which will remain in good sowing condition for some time. Altogether it is a very convenient manure to handle, and a great improvement on the original nitrolim.

"It contains 15½ per cent. of nitrogen; it also contains a considerable percentage of lime, which is often an advantage, but makes it unfit for mixing with any manure containing ammonia, such as sulphate of ammonia, guano, etc.

"Nitrate of lime has been on the market for several years, and is now more generally known. It is a greyish material containing 12¾ per cent. of nitrogen, and also about 25 per cent. of lime.

"Its great drawback is that it tends to absorb moisture from the air, and to become wet and sticky, and it then has a burning effect on the skin. The present product is, however, much improved in this respect, and if proper care is taken in using it no trouble need ensue.

"The following precautions should be attended to:—The barrels containing it should be stored in a dry place, and should be kept closed until the material is required. It should be sown on a dry day. If mixed with superphosphate it forms a dry and easily-sown mixture which does not become wet and sticky so quickly. Such a mixture must, however, be sown immediately after being made. This manure continues to be considerably dearer per unit than other nitrogenous manures, and this, coupled with the greater difficulty in handling it, are against its more extensive use."

Granular nitrolim was tested against sulphate of ammonia for potatoes on a light loam previously cropped with oats. The two manures were added to dressings of 15 tons dung, 3 cwt. superphosphate and 1 cwt. muriate of potash. With early varieties sulphate of ammonia (1½ cwt.) gave a larger total yield by 1⅓ tons than granular nitrolim (1⅞ cwt.). With a maincrop variety granular nitrolim (1⅓ cwt.) gave a larger total yield by nearly 1 ton than sulphate of ammonia (1 cwt.).

The results of tests on mangolds with the manure will be found below (p. 1301).

Bacterised Peat and Sulphate of Manganese (*Midland Agric. and Dairy Coll., Rept. on Field Trials*, 1915).—Bacterised peat is sent out in two forms, viz.:—(1) As a fibrous material for incorporating with the soil, and (2) as a powder for top dressing.

The powder was applied as a top dressing to wheat and "seeds" hay at the rate of 7 cwt. per acre, but produced no result whatever on either crop.

The fibre was tested with potatoes, 5 cwt. per acre being used. The results were again entirely negative.

Sulphate of manganese was tried for "seeds" and potatoes, but with negative results.

Sulphate of Ammonia (*La Vie Agricole et Rurale*, abs. in "*Fertilisers.*") —In experiments on the application of sulphate of ammonia at different depths the best use of the manure was obtained by burying to a depth of at least 4 in. Applied as a top dressing, the greatest proportion of nitric nitrogen remained in the upper 4 in., to the disadvantage of a tap-rooted plant such as beet. Whilst the control plot was only able to supply 5 mg. of nitric nitrogen per 100 mg. of dry earth, the manure had provided 6·8 when applied as a top dressing, 7·7 when buried at a depth of 2 in., 9·5 at a depth of 4 in., 8·8 at 7 in. and 9·1 at 12 in.

Testing for Acidity of Soil with Litmus Paper (*Canadian Dept. of Agric., Chemistry Div., Bull.* 80).—In this bulletin, two methods of testing for acidity or sourness in soil by means of litmus paper are described :—

" 1. Take up, by means of a spade or trowel, a little of the surface soil from, say, half a dozen places on the area to be examined, and mix well, using the trowel or a clean piece of board. Do not handle the soil. Take a small quantity (a few ounces) of the mixed soil and, putting it in a clean cup or tumbler, pour on a little boiled water and stir with a clean piece of stick or spoon until the mass is of the consistency of a very thick paste. Into this " mud " press a piece of blue litmus paper by means of a small stick or the back of the knife, inserting the paper until one-half to two-thirds of its length is within the pasty mass. At the end of fifteen minutes carefully draw out the paper and note if the part that has been in contact with the soil has turned red. If so the soil is acid.

" 2. Place a strip of blue litmus paper in the bottom of a clean, dry, glass tumbler (preferably flat-bottomed), and over it place a round " filter paper " (purchasable at a druggist's) or, if such is not readily obtainable, a piece of clean white blotting paper cut to fit the bottom of the tumbler. On this put a few ounces of the soil to be tested, collected and mixed as already described, and pour on sufficient boiled water to moisten or wet the soil thoroughly throughout its mass, but no more, and set aside for half an hour or longer. To examine the litmus paper the tumbler is inverted ; viewed through the bottom of the glass its colour will be well brought out against the white filter paper. As a check, and to ensure that any change in colour may not be due to acidity of the water or filter paper used, a blank test should be made in the same manner, but using no soil."

Soluble Humus and Productiveness of Soil (*Jour. Agric. Sci., Vol.* VII., *Pt.* 2 ; *W. Weir, M.A., B.Sc.*).—The soluble humus in the soil was removed by washing the soil with dilute hydrochloric acid to remove bases, and then repeatedly extracting with dilute soda. Some 40 per cent. of the nitrogen in the soils was thereby removed. Vegetation experiments were then conducted with extracted and untreated soils during two seasons, and approximately equal total yields both of dry matter and of nitrogen were obtained with each soil over four successive crops. It appeared that the removal of the soluble humus did not diminish the productiveness of the soil, in spite of the fact that the soil used was known to respond to nitrogenous fertilisers.

Laboratory experiments indicated that the removal of the soluble humus increased the amount of ammonia but diminished that of nitrates in the soil, and the sum of ammonia and nitrates was usually less in the extracted than in the untreated soil. The numbers of bacteria, however, were considerably increased. It is stated that the laboratory results are not necessarily inconsistent with the vegetation experiments ; since the accumulation of ammonia and nitrate in an uncropped soil will only proceed to a certain stage, while where crops are grown the nitrate is perpetually being removed by the growing plant.

FIELD CROPS.

Varieties of Potatoes (*Edinburgh and E. of Scot. Coll. of Agric., Report Lft., Ser. A., No.* 1).—Potatoes were grown in 1914 following a

received 6½ cwt. per acre of mixed artificials, supplying about 5 per cent. nitrogen, 16 per cent. soluble phosphate and 6 per cent. potash, at the time of planting, which was carried out in the third week in April. The figures given below represent the total of saleable produce.

The yields of early varieties were:—Epicure 11 tons 12 cwt.; Mid-Lothian Early 10 tons 16 cwt.; Ninetyfold 10 tons 15 cwt.; Eclipse 10 tons 2 cwt.; Sharpe's Express 7 tons 14 cwt.; New Success 4 tons 18 cwt. The quality of produce of Ninetyfold was stated to be inferior.

The second early varieties yielded as follows:—Macpherson 11 tons 7 cwt.; British Queen 10 tons 19 cwt.; King Edward 10 tons 7 cwt.; Harbinger 10 tons 6 cwt.; Ochil Queen 10 tons 2 cwt.; Sutton's Abundance 9 tons 11 cwt.; Queen Mary 9 tons 3 cwt.; Bishop 8 tons 18 cwt.; Culdees Castle 6 tons 9 cwt. Two new varieties were included—Ochil Queen, a strong-growing sort of the British Queen type, and Bishop.

The yields of late varieties were:—Seedling 12 tons 17 cwt.; Economist 12 tons 0 cwt.; Up-to-Date 11 tons 15 cwt.; Ochil King 11 tons 12 cwt.; Summit 11 tons 10 cwt.; Legaston Don 11 tons 2 cwt.; Factor 11 tons 0 cwt.; Arran Chief 10 tons 18 cwt.; Iron Duke 10 tons 18 cwt.; Arran Hope 10 tons 15 cwt.; Imperial 10 tons 8 cwt.; Templar 9 tons 16 cwt.; Vitality 9 tons 13 cwt.; Baronet 9 tons 8 cwt.; Northern Star 9 tons 7 cwt.; Dalhousie 9 tons 5 cwt.; Golden Wonder 7 tons 18 cwt.; What's Wanted 7 tons 12 cwt. Three new varieties were tested—Seedling, Economist and Ochil King.

Potato Experiments (*Dorset C. C. Educ. Com., Agric. Lft. No. 2*).—The soil was a fairly stiff sandy loam on the Reading Beds formation in Dorset. The conclusions are drawn from the 1915 trials that on similar soils in the county the varieties which may be grown with success are:—Sir John Llewellyn and Eclipse (earlies); Pioneer Queen, Colleen, Great Scot, British Queen, Culdees Castle and Epicure (second earlies); and Conquering Hero, Arran Chief, Lochar, Table Talk, King Edward VII., Balmoral Castle, Up-to-Date, Clarke's Maincrop, Dalhousie Seedling and Duchess of Cornwall (maincrop varieties).

Sprouted seed produced a larger and more profitable crop than unsprouted seed.

As regards change of seed it is recommended that at least half the stock should be changed every season.

Spraying with Bordeaux mixture against disease was found beneficial and profitable.

More saleable potatoes were produced at a less cost from "earthed" than from "unearthed" plants.

The best distances to plant were found to be from 24 to 28 in. between the rows and from 12 to 16 in. between the sets for maincrop varieties.

Varieties of Potatoes (*Midland Agric. and Dairy Coll., Rept. on Field Trials*, 1915).—A large number of varieties were tested, comprising early varieties lifted when green, early varieties allowed to ripen off, second early varieties, main-crop varieties and late varieties. Remarks on the yields and descriptive notes are given.

Ripe v. Unripe Seed Potatoes (*Midland Agric. and Dairy Coll., Rept. on Field Trials*, 1915).—The seed was the King Edward variety and was planted on a light loam, following oats. Unripe seed gave 10¾ tons of ware and 1¼ tons of seed per acre, while ripe seed gave 4¾ tons of ware and 16 cwt. of seed per acre.

The results of this trial in 1914 and 1915 conclusively confirm the generally accepted view that immature seed potatoes are best. Potatoes for seed purposes should therefore be raised when the tops have withered, but are still green, *i.e.*, about a month before they are dead ripe.

Ripe v. Immature Seed of Potatoes (*Jour. Dept. Agric. Victoria, June*, 1915).—In a test of ripe and immature seed for planting, whether whole or cut, the following results were obtained :—Ripe seed, whole, 4 tons ; ripe seed, cut, 1¾ tons ; immature seed, whole, 5½ tons ; immature seed, cut, 4¾ tons per acre. At a second centre the increase due to immature compared with ripe seed was 2 tons 6 cwt. per acre.

Varieties of Spring Wheats (*Midland Agric. and Dairy Coll., Rept. on Field Trials*, 1915).—On a light gravelly loam after roots, 3 bush. per acre of seed of four varieties of spring wheats were sown on 5th March. The yields of saleable grain per acre in qr. (of 504 lb.) were :—Dreadnought 4½. Red Marvel 4¼. Sensation 4, Marquis 3. Marquis came into ear and also ripened fully a fortnight before Red Marvel or Dreadnought. Sensation was distinctly the slowest in growth. It is concluded that, in the Midlands, Sensation should be sown not later than the third week in February, Dreadnought up to the first week in March, Red Marvel a week later, and Marquis up to the beginning of April.

Varieties of Oats (*Midland Agric. and Dairy Coll., Rept. on Field Trials*, 1915).—The following yields of saleable grain per acre were obtained (qr. of 336 lb.) :—Victory, 7¾, Wideawake 7½, Crown 7¼, Abundance 7. Beseler's Prolific 7, Scottish Chieftain 6¾, Golden Rain 6, Record 6. Triumph White 5¾. Yielder 5¾, Giant Eliza 5, Leader 4¼. Leader. Yielder and Record are evidently more suitable for good, rich soils than for the light gravelly loam on which these experiments took place.

Varieties of Oats (*West of Scot. Agric. Coll., Bull.* 71).—These experiments were carried out during the five years 1907-11. The following average yields were obtained, per acre :—

No. of Expts.	Variety.	Grain.	Straw	No. of Expts.	Variety.	Grain.	Straw
		lb.	cwt.			lb.	cwt.
84	Beseler's Prolific	2,631	39	65	Golden Rain ..	2,317	33
93	Wideawake ..	2,570	38	109	Potato ..	2,309	44
37	Awnless Probstei	2,550	41	42	Twentieth Century	2,286	34
108	Mounted Police	2,542	39				
68	Lincoln ..	2,499	40	110	Sandy	2,279	46
70	Waverley ..	2,485	37	52	Thousand Dollar	2,270	38
44	Storm King ..	2,429	36	23	Siberian ..	2,208	37
65	New Abundance	2,380	36	23	Danish Island	2,180	37
69	Viking	2,373	37	23	Bavarian ..	2,063	38
95	Banner	2,349	38	20	White Giant ..	2,048	37

As regards harvest, the early varieties were Storm King, New Abundance, Golden Rain, Twentieth Century, Viking, Danish Island, White Giant ; the intermediate varieties were Waverley, Beseler's Prolific, Thousand Dollar, Mounted Police, Lincoln, Banner, Bavarian ; the late varieties were Potato, Sandy, Wideawake, Awnless Probstei.

As regards soil, Beseler's Prolific, Wideawake and Mounted Police are stated to do well on nearly any type of soil, though Wideawake

does relatively better than the other two on poor soils. Lincoln gives a good return on heavy to medium soils, while Banner and Waverley give relatively better returns on the lighter classes of soil. Viking does well on good soil and in good seasons, but suffers more than the three first-mentioned under adverse conditions; New Abundance is similar to Viking. Thousand Dollar is not recommended.

Varieties of Mangolds (*Midland Agric. and Dairy Coll., Rept. on Field Trials*, 1915).—The results of mangold trials carried out for several seasons are summarised as follows:—*Golden Tankard* has proved an uncertain cropper; it is the best keeper and has a high feeding value; it does best when sown early on rich, deep soil with a good surface tilth. *Mammoth Long Red* has cropped well and the percentage of dry matter has been practically equal to that of Golden Tankard. *Yellow Intermediate* and *Lion Intermediate* are more certain croppers than Golden Tankard, especially on light soils; Lion has produced rather heavier crops, but is one of the poorest in percentage of dry matter. *Red Intermediate* has given the same yields as Yellow Intermediate, but its percentage of dry matter has always been the lowest of all. *Golden Gatepost* has apparently two strains, both of which are superior to Yellow and Red Intermediate in quality and beat Golden Tankard as croppers, and are well fitted for growing on medium and lighter soils for late use in place of Tankards. *Yellow Globe* has been the best and surest cropper, especially under unfavourable conditions of soil and season.

Manuring of Mangolds (*Midland Agric. and Dairy Coll., Rept. on Field Trials*, 1915).—The soil was a clay loam previously cropped with wheat.

Granular nitrolim (1½ cwt. per acre) gave 4½ tons per acre extra yield above that of sulphate of ammonia (1 cwt. per acre). The soil was lacking in lime, and it is confidently stated that on such a soil granular nitrolim is superior to sulphate of ammonia for mangolds.

While basic slag alone proved superior to superphosphate alone, a mixture of the two gave by far the best crop.

The addition of 3 cwt. salt to the manurial dressing (potash supplied by 1 cwt. muriate of potash) increased the yield by 3 tons; 4 cwt. kainit proved much better than 1 cwt. muriate of potash *plus* 3 cwt. salt.

Top dressing at the end of June with 1 cwt. nitrate of soda or 1¼ cwt. nitrate of lime or 1 cwt. granular nitrolim proved very profitable. The two nitrates were best and of practically equal value; the granular nitrolim was not so good. Where the latter was applied on *wet* mangold leaves it burned them severely; the nitrate had no such effect.

A top dressing of 1 cwt. of salt along with the top dressings previously mentioned proved very profitable, the increases (except with nitrate of lime) being much larger on heavy soil than on light soil.

FEEDING STUFFS AND DAIRYING.

Bran and Dried Brewers' Grains (*Cockle Park Expt. Sta. Bull. No.* 23).—Bran and dried brewers' grains (separately) were compared with Bombay cotton cake and soya cake (together) as concentrated foods for cattle and sheep, the same amounts of digestible food constituents being supplied in each case.

The results are taken to show that provided the proper amounts of feeding constituents are fed, and the foods are of good quality, there

is little difference in the feeding values of the same amounts of the different foods fed in the trials. The choice of concentrated food is therefore dependent on price.

Wintering of Stirks (*Cockle Park Expt. Sta., Bull. No.* 23).—Trials were conducted in the winters of 1913-14 and 1914-15 to compare indoor and outdoor wintering of stirks; 22 blue-grey calves and 2 shorthorn and Aberdeen-Angus cross calves were used in the first trial, and 18 blue-grey calves in the second trial.

The rations used were, per 500 lb. live-weight per day (containing the same amounts of nutrients):—

1913-14.

I. (12 animals out-wintered.)	II. (6 animals in-wintered.)	III. (6 animals) in-wintered.
8 lb. meadow hay.	25 lb. swedes.	33½ lb. yellow turnips.
1 „ soya cake.	6 „ meadow hay.	6 „ meadow hay.
1 „ Bombay cotton cake.	1¾ „ soya cake.	1¾ „ soya cake.
1 „ maize meal.		

1914-15.

I. (12 animals out-wintered.)	II. (6 animals in-wintered.)
10½ lb. meadow hay.	35 lb. yellow turnips.
1 „ soya cake.	7 „ meadow hay.
1¾ „ bran.	1½ „ soya cake.
1 „ Bombay cotton cake.	

The out-wintered lots had the use of a shelter shed open to the south; the in-wintered lots were housed and fed in boxes at night and were turned out to pasture during the day.

In 1913-14 the 3 lots made practically identical live-weight gains of 6½ lb. per head per week, but at the end of March a slightly higher value was put by practical valuers on those wintered outside, as they had better coats of hair, and were more promising as grazing cattle. The cost of food was slightly less for those out-wintered. Incidentally, it was shown that, provided equal amounts of dry matter are fed, swedes and yellow turnips can be substituted for each other.

In 1914-15 those out-wintered gained 4 lb. per head per week live-weight, and those in-wintered 4·7 lb. The gain per head from the out-wintered lot was 11*s.* 10*d.*, and from the in-wintered lot 20*s.* 9*d.*

It has now been demonstrated at Cockle Park for 4 winters in succession that young cattle from 6 to 12 months old can be wintered with excellent results on pasture, if they have access to a shelter shed, and receive suitable additional food. At the end of the winter those wintered outside have better coats of hair, and will command higher prices as grazing cattle. They also possess the great advantage of practical freedom from tuberculosis (see also this *Journal* for April, 1915, p. 71, and December, 1914, p. 842).

Winter Feeding of Bullocks (*Brandon Exptl. Farm, Canada; "Farmer's Advocate," Winnipeg*, 16th June, 1915).—The bullocks were divided into four lots, two of which were wintered in a stable, while two were kept outside with only an open shed for shelter. All four lots received the same grain ration. One of the lots wintered indoors received straw and maize silage as fodder, while the other had mixed hay. One of the outside lots was given lucerne as fodder, the other receiving mixed hay. The animals were sold in the spring after 191

days' feeding. The results of the experiment were as follows, the figures showing the average per bullock :—

	Average gain in 191 days.	Average cost of food.	Average profit over cost of food.
	lb.	£ s. d.	£ s. d.
Wintered indoors—			
Lot I.—Mixed hay ..	362	7 14 4	1 11 9
,, II.—Straw and maize silage	319½	7 7 1	1 12 10
Wintered outside—			
Lot III.—Mixed hay ..	314	8 2 8	15 2
,, IV.—Lucerne	329	8 5 6	16 11

It will be seen that, of the bullocks fed on mixed hay, those wintered indoors made a considerably higher gain and yielded more than double the profit obtained from the outdoor lot. Under exactly similar conditions straw and maize silage proved more profitable as fodder than mixed hay, though producing a smaller gain in weight; lucerne gave a rather higher profit than mixed hay.

Pig Feeding with Uncooked Meals (*Cockle Park Exp. Sta., Bull.* 23).—These trials were conducted to ascertain whether it was possible to feed pigs profitably on meals *alone* in Northumberland.

In both 1913 and 1914 four young pigs were bought at 8 weeks old, and the trial was concluded in each year when they were 32 weeks old. In the first of these 6 months the pigs were allowed, in 1913, 1½ pts. of milk per head daily, and in 1914, ½ gal. of skim milk daily; throughout the whole period the meal, otherwise forming the sole food, consisted of maize and gram, crushed and fed in the form of a cold "crowdy" (mixture of meal and water).

The pigs in 1913 cost, on the average, £1 5*s*. to purchase, and the cost of the food for the period was £1 8*s*. 3*d*., making a total of £2 13*s*. 3*d*. per head. The sale value of each pig at the end of the trial was £3 14*s*. 5*d*., leaving £1 2*s*. 2*d*. as the gain per pig. Each pig consumed 389 lb. meal and made a gain of 135 lb. live-weight; neglecting the small amount of the milk fed, about 3 lb. meal produced 1 lb. live-weight increase.

In 1914 the pigs cost £1 8*s*. each and sold for £5 10*s*. each. The food cost £2 13*s*. 8*d*. for the 24 weeks, leaving £1 8*s*. 4*d*. as the gain per pig. The pigs each consumed 830 lb. meal and made a gain of 215 lb., so that, again neglecting the milk fed, about 3⅘ lb. meal produced 1 lb. live-weight increase.

The amount of food fed in the first month was 8½ lb. maize and 40 lb. gram per 1,000 lb. live-weight per day, gradually changing by the sixth month to 16¼ lb. and 18½ lb., respectively, in 1913, and to 18$\frac{3}{10}$ lb. and 20½ lb. in the 1914 experiment.

Feeding of Straw to Pigs (*Fuhling's Landw. Ztg.*, 1st and 15th December, 1915).—There has been some discussion in Germany as to whether grinding straw increases the digestibility of the fibre. In these experiments carried out with 3-months-old pigs from February to August, 1915, it was found that even a partial substitution of finely ground straw for fine wheat bran (increased from approximately 2 lb. to 4 lb. over the period) in the ration seriously interfered with successful

fattening and the utilisation of the total ration ; when the straw " meal " completely replaced the bran, the live-weight was reduced practically to one-half. With no straw, 1 lb. live-weight increase was obtained from 1·6 lb. protein and 9·9 lb. starch equivalent ; with half straw in place of half bran, 2·1 lb. protein and 15·6 lb. starch equivalent ; with straw completely replacing bran, 2·1 lb. protein and 20·2 lb. starch equivalent.

Feeding Value of Grasses (*Die Landw. Versuchs-Stat.*, *LXXXVII.*, 4 & 5 ; *F. Honcamp and others*).—The following results were obtained from digestibility experiments on sheep. The figures are reckoned as percentages of dry matter + 15 per cent. of water.

Grass.	" High " Moor Soil, 1911.		" Mineral " Soil, 1912.		Marsh Soil, 1912.		Marsh Soil, 1913.	
	Dig. Protein.	Starch Equiv.	Dig. Protein.	Starch Equiv.	Dig. Protein.	Starch Equiv.	Dig. Protein.	Starch Equiv.
Lolium perenne ..	4·10	39·9	—	—	2·02	25·9	1·37	28·4
" italicum ..	2·20	40·8	—	—	2·05	29·8	—	—
Dactylis glomerata	3·34	35·6	—	—	2·57	27·4	1·01	23·6
Phleum pratense ..	2·28	40·8	— / 0·71	30·8 / 34·1	3·02	27·5	0·97	27·2
Poa pratensis ..	4·58	36·0	—	—	—	—	—	—
" trivialis ..	5·18	40·9	—	—	—	—	—	—
Festuca pratensis ..	3·68	39·9	—	—	—	—	2·09	27·7
" rubra ..	3·11	38·6	—	—	5·46	34·2	1·28	22·1
Agrostis vulgaris ..	—	—	1·73	41·0	—	—	—	—
Average	3·56	39·1	1·22	35·3	3·22	28·9	1·46	26·4

Former experiments carried out by the investigators had given the following figures for starch equivalent (on dry matter + 15 per cent. water) :—" High " moor hay, 36·06 ; clover hay, 32·54 ; marsh hay, 30·37 ; " low " moor hay, 28·59. The conclusion is drawn that " high " moor, if properly cultivated, yields a fodder quite equal, and even surpassing, in feeding value that on " mineral " or marsh soils.

Hempseed Cake for Dairy Cows (*The Analyst*, October, 1915 ; *H. T. Cranfield and M. G. D. Taylor*).—The composition and quality of milk and butter produced by feeding hempseed cake was quite equal to that obtained by feeding linseed cake.

The effect of removing cows from poor pasture on to a well-balanced ration in the stall was shown very strikingly by the data obtained. It caused a large fall in the percentage of fat, a considerable rise in the Reichert-Meissl, Kirschner and Polenské values, and a fall in the refractometer figure.

Pigmentation of Bacon (*Jour. Agric. Sci., Vol. VII., Pt.* 2 ; *K. J. J. Mackenzie, M.A., and F. H. A. Marshall, D.Sc.*).—Former investigation having shown that no mammary pigment could be detected in the old sows examined, the present test sought to establish whether such pigment had previously been present in the sows, and had been destroyed or removed during the periods of glandular activity. Four sows of coloured varieties were taken, three being Large Blacks, and one a Berkshire. All four animals were operated upon on the same date, and pigment was found to be present in the mammary glands in each case. All the sows subsequently had two litters, and later on they were killed on the same day, when it was found that in three

cases the pigment had entirely disappeared, and in the fourth case only a very slight trace remained.

These experiments are held to prove very clearly that pigment may be no longer present in sows which have been bred from. While the precise period or periods at which the pigment disappears is unknown, there is a strong presumption that this takes place either during the progress of lactation or in the period of pregnancy when the mammary glands are being built up preparatory to the secretion of milk.

Effect of Time of Milking on Quantity and Quality of Milk (*Durham C. C., Offerton Bull. No. 5; F. P. Walker, M.Sc.*).—This experiment lasted over two periods of 6 weeks each, and the cows were divided into two lots. During the first period Lot I. was milked at 6 a.m. and 6 p.m., and Lot II. at 6 a.m. and 4 p.m., while during the second period the times of milking of the two lots were reversed.

The total amount of milk did not appear to be influenced by the equal or unequal periods of milking, but, as is usually the case, uneven periods of milking resulted in a reduction in the butter fat content of the morning milk, while an even interval tended to obviate this. The cows which were milked at even periods gave more milk in the evening than in the morning, though the evening's milk was slightly poorer in quality than the morning's.

In a note on the above experiment it is stated that the results tend to confirm a theory previously formulated, namely, that if cows are milked at 6 a.m. and 6 p.m. the evening's milk will be 0·2 per cent. poorer in fat than the morning's, and that for every half hour earlier the evening's milk is obtained it gains 0·25 per cent. over the morning's fat content, so that milk obtained at 3.30 p.m. is 1·05 per cent. richer than that got at 6 a.m.

Comparison of Milking Twice or Three Times a Day (*Durham C. C., Offerton Bull. No. 5; F. P. Walker, M.Sc.*).—One lot of cows were milked at 6 a.m. and 6 p.m., and the other lot at 5 a.m., 12.30 p.m. and 6 p.m.; after 6 weeks the two lots were interchanged for a further 6 weeks. The results showed no advantage in milking three times daily, and the extra labour would be considerable. Moreover, the milk in the morning from cows milked thrice daily was often of a poor character, and fell below the 3 per cent. limit.

Effect of Increasing the Amount of Calcium Phosphates in the Rations of Cows on the Composition of the Milk (*Paper read at the British Association Meeting, 1915; A. Lauder, D.Sc., and T. W. Fagan, M.A.*).—The general opinion of previous workers that the composition of the mineral matter in the milk could not be readily affected by adding mineral matter to the food was confirmed by this experiment, in which calcium phosphate was added to the rations for five weeks in amount rising to eight ounces per head per day. There was no increase in the amount of phosphoric acid, the percentages of fat, ash and "solids not fat" were not affected, and no definite effect on the yield was observed.

Effect on Yield and Quality of Milk of Feeding Phosphate to Cows (*Durham C. C., Offerton Bull. No. 5; F. P. Walker, M.Sc.*).—Precipitated bone ash, containing about 70 per cent. of phosphate of

lime, was fed to milking cows on pasture at the rate of 1 oz. per head per day, the cows receiving also a concentrated ration. The phosphate seemed to have very little effect on the quantity or quality of milk, and did not cause a stimulation of the nervous system of the cows, such as had been thought possible. The only result from feeding the bone ash seemed to be a slight increase in carcass weight.

POULTRY.

Egg-Laying Competitions at Harper Adams College (*Poultry Competition Monthly*, issued by the College, *Vol. I.*, *No.* 3).—The third period of the 12 months' and 2 years' laying competitions terminated on 25th December. During the third period eggs reached the maximum price, viz., 2*s.* 11*d.* per doz. in the week ending 8th December. The number of eggs laid and their value in each section of the competition for the 12 weeks are as follows :—

Average per Pen of Six Birds (including unrecorded eggs).	12 Months' Competition.		Two Years' Competition.	
	Eggs.	Value.	Eggs.	Value.
		s. d.		*s. d.*
Section I. (Leghorns)	123.3	24 5	106.8	20 10
„ II. (Wyandottes)	131.2	26 4	119.4	23 3¾
„ III. (Rocks, Orpingtons and Rhode Island Reds).	105.0	21 3¾	112.4	22 4
„ IV. (Sussex)	—	—	95.75	18 7
„ VI. (Farmers' and Small Holders' Section) ..	110.4	22 1½	—	—
All the birds	122.3	24 5	111.2	21 10

Section V. was intended for "any other non-setting breed," but no entries have been received.

Tumours in Fowls (*Jour. Agric. Research* [U.S.A.] 29th November, 1915 ; *Maynie R. Curtis*).—The following conclusions are based on an examination of data collected during 8 years' autopsy work at the Maine Agricultural Experiment Station :—

Nearly 9 per cent. of the birds had tumours, there being no real difference in this respect between birds which died from natural causes and apparently normal birds which were killed.

The occurrence of tumours increased with age : only 7 per cent. of the birds under 2½ years had tumours, while neoplasms were present in 19 per cent. of those over that age.

In birds which died from natural causes, the tumours were directly or indirectly the probable cause of death in from one-third to one-half the cases.

Hypertrophied liver, spleen, or kidney tended to be associated with the presence of tumours in other organs ; death often resulted from internal hemorrhage from the tumour, the underlying tissue, or the hypertrophied liver and spleen.

The organs most frequently affected in the females were the genital organs ; in most cases the tumours were confined to one organ.

NOTES ON AGRICULTURAL CO-OPERATION.

The Organisation of the Milk Supply.

Co-operation between farmers for the disposal of their milk may lead to improvement in the purity and regularity of the supplies, to a better price being obtained by the producer, and to the removal of difficulties in connection with the disposal of surplus milk. Co-operation should prove of advantage not only to the farmers themselves, but also, from the point of view of the improvement of purity, to the general public as consumers.

Purity.—The purity of milk as it reaches the consumer is likely to be improved by the organisation of the producers, since it is to be expected that the milk will receive more effective treatment for the removal of impurities at the common collecting centre than on individual farms; and, further, clean methods on the farm are much more likely to be adopted under a co-operative system, since members must conform to the society's regulations.

Disposal of Surplus Milk.—Co-operation should facilitate the disposal of the surplus milk, which could be converted into cheese, cream or other milk products at the collecting depot, and it has been found profitable in some cases to establish a central depot, solely, or almost solely, for the disposal of surplus milk.

Some societies, for example, make cheese with great success. One society collects cream and makes it into butter at a central creamery. A Welsh society has adopted a system of butter blending as an alternative to making butter; the farmers make the butter themselves and send it, unsalted, to the premises of the society, where it is blended by an up-to-date plant. Another society converts its surplus milk into cream and separated dried milk powder.

The central depot is much more likely to be able to secure efficient marketing than the individual farmers. Among other advantages the produce could be graded and standardised, and public attention could be attracted and its confidence retained by efficient advertising and the use of names and brands.

The Collecting Depot.—The first step to be taken by dairy farmers who have agreed to combine to dispose of their milk, is the establishment, preferably at or near a railway station, of a milk *collecting depot*, equipped with a refrigerating plant and cold store, as well as with the necessary plant and utensils for the manufacture of cheese, butter, and other forms of milk products. The provision of an ample supply of pure cold water is essential for refrigerating purposes. The milk of the district would be brought to this depot, and, after being tested and thoroughly refrigerated, cleansed and pasteurised, it would be dispatched by rail or motor to the retail depots or shops in the large centres of population, as well as to public institutions, hotels and restaurants.

Creameries or depots may cost from £1,500 to £10,000 to erect and equip, but no hard and fast rules can be laid down, either as regards the plan on which the depot is to be erected and equipped or the formation of a society, since due allowance will have to be made for the varying conditions in different districts. In one centre the primary object may be a milk depot for the treatment and distribution of milk, with a plant sufficient to deal with the manufacture of the surplus into cheese; at another centre the business may be partly a milk trade

and partly the manufacture of milk products; while in some districts milk selling will be quite out of the question, and cheese-making in summer and butter-making in winter will be advisable.

Capital and Business Management Necessary.—It must be borne in mind that a society should not commence to trade until adequate capital has been provided to start and carry on its business, and that a society cannot hope to succeed unless it is controlled by business men and is in a position to employ a competent manager and staff.

The capital of some of the largest societies in this country ranges from about £2,500 upwards, and the turnover from about £20,000 upwards.

Some of these societies have adopted a principle which it is very desirable should be extended, not only in co-operative milk selling but in other forms of agricultural co-operation, viz., *trading with industrial co-operative societies.* As an example, one society, in addition to trading with ordinary retailers, and disposing of nearly 1,000 gallons daily to public institutions, sells about 2,000 gallons of milk daily to an industrial co-operative society.

By-laws.—To carry out a scheme for the organisation of the milk supply on a proper basis, by-laws would have to be drawn up, regulating the conditions under which the milk should be produced and dealt with before it reaches the depot. Many of the co-operative dairy societies affiliated to the Agricultural Organisation Society have drawn up such by-laws. The societies are registered under the Industrial and Provident Societies Act, 1893, and have in most cases adopted the model rules of the Agricultural Organisation Society. Model rules for co-operative dairy societies may be obtained from the Agricultural Organisation Society, Queen Anne's Chambers, Tothill Street, Westminster, S.W., who will be pleased also to supply further information as to co-operation in the dairying industry, and to assist with advice in the formation of co-operative societies.

OFFICIAL NOTICES AND CIRCULARS.

Foot-and-Mouth Disease.

No outbreak of foot-and-mouth disease has occurred on any premises in Great Britain since that confirmed on the 11th February at the County Asylum, Wells, Somerset, mentioned in last month's *Journal.* The district scheduled in connection with that outbreak, to which restrictions on the movement of animals were applied, was gradually reduced and all the restrictions were withdrawn by an Order of the Board which came into operation on the 13th March.

In connection with the tracing of certain calves sold from premises at the Wells County Asylum, it was found that some of them had been moved to the Midlands and exposed for sale in certain markets in Warwickshire and Oxfordshire. It was considered advisable, therefore, as a precautionary measure, to make an Order prohibiting, for the time being, the exposure of animals for public sale or exhibition within an area surrounding those markets, and also prohibiting the movement of animals out of that area. This Order was made on the 14th February. The calves concerned having been traced and no foot-and-mouth disease having been found either in them or any other animals in the area scheduled, the Order was revoked on the 22nd February.

Carrying of Lights at Night on Farms.

The attention of the President of the Board of Agriculture and Fisheries has been drawn to the possibility of farmers and shepherds, by carrying lights at night when attending stock, rendering themselves liable to prosecution under the Lighting Regulations at present in force,

Lord Selborne has been in communication with the Home Office, and is advised that the sole requirement is that such lights must be properly screened.

It is understood that a lamp of a special pattern has been manufactured at the suggestion of the National Farmers' Union in Lincolnshire, but the use of any particular pattern of lamp is not necessary.

One simple arrangement which has been adopted is to place the light in a biscuit tin with straight sides.

Sulphate of Ammonia: Purchase and Use by Farmers.

THE following Circular Letter, dated 18th February, 1916, regarding the purchase and use of sulphate of ammonia by farmers, has been addressed to the secretaries of County War Agricultural Committees:—

SIR,—I am directed by the President of the Board of Agriculture and Fisheries to refer to the notice recently issued as to the suspension of licences for the export of Sulphate of Ammonia, and to enclose copies of a notice* and leaflet† which have been issued, and to which he hopes you will give the widest publicity possible. Will you let me know how many copies could be distributed with advantage in your district?

In order that your Committee may be in possession of full information on this matter, I am further instructed to enclose extracts from speeches‡ made by Lord Selborne and Mr. Acland to a deputation received at the Board's offices on the 2nd instant from the Central Chamber of Agriculture with reference to the position as regards Sulphate of Ammonia. It will be seen that the President desires to encourage, to as great an extent as possible, the use of sulphate of ammonia by farmers this spring, and to urge them to purchase their supplies without delay. Lord Selborne hopes, therefore, that War Agricultural Committees will at once take such steps as they may deem most effective to support the efforts he is making in this direction.

I am also to forward copies of lists§ of makers of sulphate of ammonia to whom the farmers in your district might apply for such supplies as they require. As, however, makers are sometimes not very willing to deal with small orders, and do not usually give credit, it has been considered desirable to add to the list of makers the names of certain dealers who are stated by the Sulphate of Ammonia Association to be sellers of sulphate of ammonia. The Association inform the Board that the price asked by these merchants should not exceed £16 15*s*. per ton, including bags, free on rail, but the Board have on this occasion not been able to make any arrangement as to the terms, which must be a matter for negotiation in each case.

Lord Selborne desires to lay stress on the importance of urging farmers to place their orders without delay. Owing to the fact that

---

* See *Journal*, February, 1916, p. 1180. † See p. 1267.
‡ Printed below. § Not here printed.

sulphate of ammonia is an important by-product in connection with the manufacture of certain materials required by the Ministry of Munitions, it will not be possible to continue the suspension of licences for export unless it can be proved that there is an effective demand for sulphate of ammonia by farmers sufficient to prevent any interference with the production of explosive materials.

I am, &c.,
SYDNEY OLIVIER,
Secretary.

ENCLOSURE TO ABOVE LETTER.

Extracts from Speeches made by the President and the Parliamentary Secretary of the Board of Agriculture and Fisheries to a Deputation from the Central Chamber of Agriculture on the 2nd February, 1916.

The President, in the course of his speech, said :—

I want first of all to come to the question of sulphate of ammonia. What you have said to-day is practically this, that the increase in the price of sulphate of ammonia since the war is justified by the increase in the cost of production ; but that the price before the war was not justified, and the Government ought to intervene to fix a price. I am not prepared without examination to accept the statement which has been made as to the pre-war cost of producing sulphate of ammonia. You must remember there are a great many producers of sulphate of ammonia, the gas works, the shale oil works, the coke ovens and the Mond process, and while I am not in a position to say that no producer of sulphate of ammonia could produce at (say) £5 per ton, I am perfectly certain that they could not all do so, and that in most cases such a price would cause the producer to go out of business.

The Government cannot fix prices except by Act of Parliament, and no Act has been passed by Parliament which would empower us to fix the price which should be charged to farmers for sulphate of ammonia. The moment it was proposed to get an Act of Parliament to do that, you would have people demanding a fixed price for all your products.

I have been very strongly pressed by influential interests in this country to interfere with the prices which farmers are getting for their produce, but I have resolutely refused. It is impossible for me to consider fixing maximum prices for what the farmer uses if I am to maintain the position that maximum prices are not to be fixed for what he produces.

The sale of 300,000 tons of sulphate of ammonia abroad at £17 per ton is a real contribution towards the solving of the difficulties of financing the war and steadying the foreign exchange; therefore, it was no easy matter, with those big financial considerations against us, to have stopped the export of sulphate of ammonia. I do not hold out any hope of fixing a maximum price for sulphate of ammonia, but I hope the steps we have taken will automatically reduce the price to a certain extent.

The comparative manurial values of the different fertilisers show that sulphate of ammonia at £16 10*s.* a ton is of the same value as nitrate of soda at £13 10*s.* a ton, and very few farmers at the present moment would hesitate to buy nitrate of soda at £13 10*s.* a ton if they had a chance.

The Parliamentary Secretary to the Board of Agriculture and Fisheries, in the course of his remarks, said :—

As you are all aware, we made in the autumn a special arrangement with the Sulphate of Ammonia Association whereby they should sell

under certain conditions sulphate for use as an autumn dressing in November and December at £14 10s. a ton. That arrangement had in it the element of a bargain. We were pushing the use of sulphate of ammonia, which we believe to be a thoroughly sound thing in certain parts of England, Wales and Scotland, though not by any means universally, and, in return for that, the makers agreed to drop their price below that which they could have obtained in other markets. This arrangement could not be continued into the spring, as we could not insist on makers selling at an especially low price for the ordinary normal supplies which agriculturists take in the ordinary course of their business. All through the autumn we have been urged by farmers and representatives of farmers to prohibit the export of sulphate of ammonia, but we did not do this as there did not seem to be any certainty that we could get anything like the total production of that fertiliser taken up and actually used by the agricultural community.

Now that the time of the year has arrived when it is extremely desirable in the interests of the nation that sulphate of ammonia should be bought and used in large quantities, the question of the prohibition of export has presented itself in a different form from what it did in the autumn, and it has recently been decided absolutely to suspend the issue of licences for export.

The Government, in the interest of food production, is responsible, and has certain powers to secure, that there shall be ample supplies. They are not in any similar way responsible, and they have not in any similar way the power, to control the price at which those supplies shall be available.

We must realise that the prohibition of export which is now in operation cannot last for ever. Four times as much sulphate is normally produced in this country as is normally consumed in this country by farmers and for commercial purposes. In many cases sulphate is produced as a by-product of industries, of which another product, if not the main product, is one or other of the materials which are extremely necessary for munition purposes. Immediately these makers find stock accumulating on their hands (which in the ordinary way they would have exported) they will claim that the suspension of exports is affecting their output of materials required for munitions. Clearly we cannot go on indefinitely refusing the demands that export should again be allowed, therefore we want farmers to realise that they ought to take advantage of the present prohibition of export to buy as much of this fertiliser as they can possibly afford to buy.

One of the difficulties is that the parts of the country where sulphate is mainly used are not parts of the country where sulphate is mainly produced; and the more farmers and merchants can fill their demands and spread them into the districts which do not normally supply the farmers, the less will be the pressure upon us to relieve the accumulations by again allowing export. The local gas works may possibly be sold out, but the farmer or dealer will find that there are ample supplies 50, 80 or 100 miles away in the industrial districts. Although that means extra railway transport it will be thoroughly worth while for the farmer or merchant to incur that little extra expense of transport in order to get the sulphate, and relieve the pressure on the supplies.

The position is a balance between two forces; the force of the farmer consuming the sulphate, and the force of those interested in munitions in preventing accumulations which are not made use of.

We wish, therefore, to point out the great importance in the farmers' interest and in the national interest, of using as much sulphate of ammonia as they can in the coming months, and (if necessary) obtaining it even from persons who do not normally supply it for agricultural purposes.

THE following Circular Letter, dated 23rd February, 1916, has been addressed by the Board to War Agricultural Committees in England and Wales:—

Employment of Women on the Land.

SIR,—1. The President of the Board of Agriculture and Fisheries desires particularly to invite the further co-operation of your Committee in improving the efficiency of the arrangements which have been set on foot to encourage the employment of women on the land.

2. This matter was dealt with in the Board's Circular Letter of the 29th November last,* and at the conference held at the Middlesex Guildhall on the 31st December last, a report of which has been sent to you, but in view of the great and growing importance of maintaining and increasing, if possible, the home production of food, Lord Selborne has decided to make a further appeal to you on the subject.

3. It is obvious that the cultivation of the land and the production of food depend upon the sufficient supply of labour. Lord Selborne has made special efforts to secure the retention on the land of farmers and of the principal classes of their skilled employees, but more men are needed for the army, and the ranks of the agricultural classes must contribute to the supply. The shortage of labour on the farms is already serious in many parts of the country, but farmers must face the fact that the situation is bound to become more difficult, and that the shortage will increase, and will be felt far more severely next spring and summer than was the case last year. In these circumstances Lord Selborne hopes that the War Agricultural Committees will take pains to make the position clear to farmers throughont the country, and will use their influence to induce them to meet the deficiency of labour by making use of the services of women, paying them reasonable wages and assisting in training them for agricultural work. Women have shown that they are fully capable of performing satisfactorily many forms of farm work, and Lord Selborne is satisfied that the shortage of labour can best be met by enlisting their aid.

4. It is not sufficient, however, that the farmers should be prepared to employ women, though this is the first essential. An appeal must also be made to the women to offer their services, and this appeal must be made on national and patriotic grounds. It must be pointed out that the production of food is essentially war work. A woman who works on a farm is doing just as valuable service to the country as if she were employed in a munitions factory or helping in a hospital, and she is bearing her part of the national burden equally with her husband, her son or her brother in the trenches or on the sea.

5. Lord Selborne has therefore been taking steps for the purpose of organising as promptly as possible a national recruiting campaign for the enlistment of women in agricultural work. Some women will be found able to give their whole time to such work. Others, particularly the wives of the labourers living in the rural districts,

---

* See *Journal*, December, 1915 (p. 862).

may only be able to offer themselves for three or four afternoons a week. Some will require training; others who have had some experience of agricultural conditions will only require some preliminary supervision. But the services of all classes will be needed; and in order to reach all classes of women there must be in every county a Women's Farm Labour Committee, with local sub-committees working in concert with the War Agricultural Committee, but carrying on its campaign with its own staff and machinery.

6. Lord Selborne recognises that considerable progress has already been made in establishing the desired organisation, and he takes this opportunity to express his warm appreciation of the co-operation he has received from County War Agricultural Committees and of the valuable work which has been done both by many women resident in country districts and by the organisers of women's work attached to the Labour Exchanges, in the establishment of women's organisations in many counties to deal with the question. Lord Selborne is glad to be able to say that the Board of Trade are increasing the number of their women organisers, and he hopes that this will make it the easier for the War Agricultural Committees throughout the country to continue to work in constant co-operation with these officers in all matters relating to women's labour, and that it will be possible to arrange for the woman organiser* for the district to be present at any meetings of your committee at which the question of women's labour on the land is likely to be discussed.

7. With the object of assisting in this work Lord Selborne has appointed Miss M. L. Talbot, Secretary of the Victoria League, to be a woman inspector of the Board of Agriculture, and she will be glad to attend and speak at any meetings to which she is invited.

8. When a Women's Farm Labour Committee for the county has been set up, it should appoint district committees or local representatives and village registrars with a view to undertaking a systematic canvass of the women of the county, and the formation of a register of those women who are willing to offer their services. This work has already been undertaken in some counties, but not in many. It is desirable that the work of the Women's Labour Committees should be kept in touch with that of the War Agricultural Committees, and it is suggested that the most convenient method of doing this is that the War Agricultural Committee should delegate to the Women's Farm Labour Committee all questions relating to women's work on the land, and that two or more members of each committee should be co-opted on the other committee.

9. A similar connection may be made between the District War Agricultural Committees and the Women's Farm Labour Sub-Committees.

10. The women's committees will arrange, where desirable, to hold meetings for the purpose of inviting and encouraging women to offer their services on the land. For such meetings, competent speakers will be required. The Women's Farm Labour Committee for the county will, no doubt, be able to supply speakers in many cases, but it has also been arranged that a panel of approved women speakers should be drawn up by the Board of Agriculture and Fisheries. If a

* Communications should be addressed to the Agricultural Organising Officer, c/o the Divisional Officer, at the addresses given at the end of this letter.

women's committee desires the services of one of these speakers, application should be made through the Agricultural Organising Officer at the Divisional Office of the Labour Exchanges.

11. The Board of Agriculture and Fisheries propose to issue leaflets, &c., on the subject of women's work on the land, suitable for distribution at meetings or otherwise, and I am to enclose copies of two reprints from the Board's *Journal*. Further copies will be supplied on application.

12. With regard to the expenses of the Women's Farm Labour Committees, I am to say that the Labour Exchanges Department of the Board of Trade are prepared to supply the committees with headed notepaper, franked envelopes, register forms, and posters for meetings, and that the Board of Agriculture and Fisheries are prepared to consider applications from them for small grants to defray the travelling expenses &c., of speakers at meetings organised by the committee. In addition, it will be open to a County War Agricultural Committee to make grants towards any other expenses of the women's committees out of the funds at their disposal, whether such expenses were included in the original estimate sent by them to the Board or not. If the grant made by the Board to any County War Agricultural Committee has been fully expended, or if grants which it might be desired to make to women's committees would cause the estimates of their expenditure which they have submitted to be exceeded, the Board will be prepared to consider an application for an additional grant, on receipt of a statement of the expenditure they have already incurred.

13. In recognition of the patriotic spirit of those women who undertake work on the land Lord Selborne proposes, in conjunction with the President of the Board of Trade, to grant a certificate, emblazoned with the Royal Arms in colours, to such women workers. These certificates will be issued to the County Women's Farm Labour Committees, who will be responsible for their distribution. It is also being considered whether an armlet should not be issued to women workers on the land.

14. Lord Selborne has also given consideration to the question of clothing suitable for women agricultural workers, and he has approved a costume consisting of a coat and short skirt of durable washing material, together with gaiters and stout boots. Samples of this costume will be supplied to the women's committees, through whom it will be possible for women workers to order them. The cost of the coat will be 10*s*. 6*d*., the skirt 5*s*., the boots 7*s*. and the gaiters 4*s*. It is suggested that farmers who employ women workers might help them in regard to their clothing by advancing the cost, and being gradually repaid, or that women's committees might raise funds locally for those who cannot afford to purchase the costume.

15. I am to add that Lord Selborne desires to commend to your committee the Women's National Land Service Corps, of 50, Upper Baker Street, London, W. The Duke of Marlborough is the President of the Corps, and Mrs. Roland Wilkins is the Chairman of the Committee. The Corps has been formed to assist the Women's Farm Labour Committees throughout the country, and to take part in the campaign for enlisting the services of women on the land, and Lord Selborne has secured for the Corps a Government grant proportionate to such sum as may be raised from voluntary contributions. The Corps proposes, in the first instance, to make a national appeal for the services of a

large number of women who will be prepared to act as forewomen in charge of gangs of women workers on the land, and to enrol them as members of the Women's Land Service Corps. Lord Selborne believes that an organisation of the kind is likely to appeal with some force to the women of the country, and he desires to say that it has his hearty approval and grateful support. He understands that the Corps proposes to send to your committee a statement of its aims and objects, and he hopes that your committee and the women's committees will make use of any assistance which the Corps can give in promoting the employment of women on the land or in supplying leaders for the women workers in any district or parish.

I am, &c.,

SYDNEY OLIVIER (*Secretary*).

Areas and Divisional Offices.

Area.	*Address of Divisional Office.*
1. LONDON AND SOUTH EASTERN DIVISION. London. Middlesex. Surrey, Sussex, Kent, Essex, Hertfordshire, Bedfordshire, Buckinghamshire, Oxfordshire, Berkshire, Huntingdonshire, Cambridgeshire, Norfolk, Suffolk.	Martlett House, Bow Street, W.C.
2. SOUTH WESTERN DIVISION. Cornwall, Devonshire, Somerset, Dorsetshire, Hampshire, Wiltshire, Gloucestershire.	Carlton House, Woodland Road, Bristol.
3. WEST MIDLANDS DIVISION. Staffordshire, Shropshire, Warwickshire, Worcestershire, Herefordshire.	Dalton House, Corporation Street, Birmingham.
4. YORKSHIRE AND EAST MIDLANDS DIVISION. Northamptonshire, Rutland, Leicestershire, Lincolnshire, Nottinghamshire, Derbyshire, Yorkshire.	South Parade, Doncaster.
5. NORTH WESTERN DIVISION. Cheshire, Lancashire.	Empire Hall, Museum Street, Warrington.
6. WELSH DIVISION. Monmouthshire and all Welsh Counties.	Law Courts, Cathays Park, Cardiff.
7. NORTHERN DIVISION. Cumberland, Westmorland, Durham, Northumberland.	Grassmarket, Edinburgh.

MISCELLANEOUS NOTES.

Notes on Crop Prospects and Live Stock Abroad.

THE *Bulletin of Agricultural and Commercial Statistics* for February, 1916, issued by the International Institute of Agriculture, shows the production of cereal crops during the past year. The countries for which it is possible to give an approximate estimate are as follows :—In *Europe*—Hungary (proper), Denmark, Spain, France, Great Britain, Ireland, Italy, Luxemburg, Norway, Netherlands, Rumania, Russia in Europe

(54 governments), Switzerland; in *America*—Canada, United States; in *Asia*—India, Japan, Russia in Asia (10 governments in 1915 and 9 governments in 1914); in *Africa*—Egypt, Tunis.

Wheat.—In the above-mentioned countries the total production in 1915 is estimated at 454,538,000 qr., against 371,283,000 qr. in 1914, or an increase of 22·4 per cent., while the area under cultivation was 7·3 per cent. greater.

Rye.—The total production in the specified countries, excluding Great Britain, India, Japan, Egypt, and Tunis, is estimated to amount to 137,370,000 qr. in 1915, against 119,395,000 qr. in 1914, or an increase of 15·1 per cent., while the area sown was practically identical in each of the two years under consideration.

Barley.—The production in the afore-mentioned countries, with the exception of India, is placed at 146,901,000 qr. in 1915, as compared with 125,102,000 qr. in 1914, the increase being equal to 17·4 per cent., but the area sown was smaller than in the preceding year by 1·7 per cent.

Oats.—The production in the above countries, exclusive of India and Egypt, is estimated to approximate to 404,472,000 qr. in 1915, or an increase of 25·6 per cent. compared with 1914, when the production amounted to 322,013,000 qr. The area sown was greater by 1·9 per cent.

Maize.—In Hungary, Spain, Italy, Rumania, Russia in Europe (54 governments), Switzerland, Canada, United States, Japan, and Russia in Asia (10 governments in 1915 and 9 governments in 1914), the total production is estimated at 417,290,000 qr. in 1915, against 371,930,000 qr. in 1914, an increase of 12·2 per cent., while the area sown showed an increase of 4·9 per cent.

Sowing of Winter Cereals.—The areas estimated to have been sown with winter *wheat* in 1915–16, compared with the areas sown during the corresponding period of 1914–15, expressed as percentages, are as follows:—Denmark 100, Spain 100, France 91, England and Wales 94, Switzerland 107, Canada 85, United States 89, India 95; with *rye*:—Denmark 100, Spain 95, France 89, Switzerland 105, United States 97; with *barley*:—Denmark 100, Spain 121, France 67, Switzerland 103; with *oats*:—Denmark 100, Spain 117, France 88.

Russia.—According to a report of the Central Statistical Committee, the production of the spring grain crops in 1915 in 56 governments and provinces of European Russia (the governments occupied by the enemy being excluded), was as follows (1914 figures are given in brackets):—Wheat, 65,274,000 qr. (65,097,000); rye, 1,317,000 qr. (1,775,700); barley, 47,189,000 qr. (42,553,350); buckwheat, 4,202,800 qr. (2,909,500); maize, 7,379,000 qr. (8,460,500); and oats, 90,812,000 qr. (80,834,000); whilst the production of potatoes was 20,451,000 tons as compared with 19,815,000 tons in 1914.—(*Broomhall's Corn Trade News*, 16th February.)

From reports received from correspondents up to the 14th November, it appeared that the area sown with winter crops was considerably less than last season, but as a result of further inquiries the Department of Rural Economy and Household Statistics states that the decrease was of no special importance in most localities, but in the south of the country and in a wide district in the south-east there was a considerable reduction, whilst in the extreme east of European Russia the acreage sown is 40 per cent. or more less than last season.—(*Broomhall's Corn Trade News*, 10th February.)

Canada.—A bulletin issued by the Census and Statistics Office at Ottawa, *on the 19th January*, states that the quality of the grain crops in 1915 was, on the whole, superior to that of last year, and also to the average of the last 5 years. The weight per bush. of the crops was as follows :—autumn wheat, 59·71 lb. ; spring wheat, 60·31 lb. ; all wheat, 60·19 lb. ; oats, 36·61 lb. ; barley, 48·26 lb. ; buckwheat, 48·02 lb. ; linseed, 55·28 lb. ; and maize, 56·32 lb.

United States.—According to a report, issued on the 8th March by the Statistician of the Department of Agriculture, the estimated stocks of grain in farmers' hands in the United States, on 1st March, were as follows (stocks on the same date in 1915 in brackets) :—Wheat 242,000,000 bush. (152,903,000 bush.) ; oats, 597,000,000 bush. (379,369,000 bush.) ; barley, 61,000,000 bush. (42,889,000 bush.) ; and maize, 1,139,000,000 bush. (910,894,000 bush).—(*Broomhall's Corn Trade News*, 8th March).

Argentina.—According to an estimate issued by the Ministry of Agriculture on the 2nd March, the acreage under maize this season is 9,929,000 acres as compared with 10,381,000 acres in 1914-15.—(*London Grain, Seed and Oil Reporter*, 3rd March).

Welcome heavy rains fell over the provinces of Buenos Aires, Entre Rios, Santa Fe and Cordoba on the 15th and 16th January. The maize situation was beginning to look very black before this, and even as it is, some considerable loss has resulted from drought in Santa Fe and Cordoba. The benefit to the maize by these last rains has been enormous, and an excellent harvest yield can still reasonably be hoped for.—(*Review of the River Plate*, 21st January.)

Climatic conditions favourable to harvest operations prevailed during the fourth week of January. Generally, the results of the wheat, oats and linseed harvests continue to be good, and well up to expectations.—(*Review of the River Plate*, 28th January.)

Australia.—According to the *South Australian Register* the official forecast of the production of wheat in 1915-16, in Australia, excluding Queensland, is 164,407,353 bush., as compared with 24,843,536 bush. in 1914-15, and 103,334,132 bush. in 1913-14 in the whole of Australia. —(*The London Grain, Seed and Oil Reporter*, 24th February).

Live Stock in France.—The numbers of farm stock in November-December, 1915, are as follows (the corresponding figures at 1st July, 1915, being shown in brackets) :—Horses, 2,156,424 (2,227,209) ; cattle, 12,514,414 (12,286,849) ; sheep, 12,379,124 (13,483,189) ; pigs, 4,915,780 (5,490,796).—(*Bulletin of Agricultural and Commercial Statistics*, February, 1916.)

Agricultural Conditions in England and Wales on 1st March.

THE crop reporters of the Board, in reporting on agricultural conditions in England and Wales during February, state that owing to the unfavourable character of February, wheat shows but little advance during the month. As on 1st February, the earlier-sown is generally satisfactory, but that got in late, or on the heavier and wetter soils, is generally rather poor and backward. Winter oats and beans are looking well, though the beans are often backward. About a third of the wheat requires, or at least would derive benefit from, a top-dressing during the spring.

The month having been very unsettled, bnt little spring work has been done. During the first half, some progress was made with the preparation of the land, and some spring wheat was sown in many parts.

of the country. But during the second fortnight the bad weather, accompanied by very heavy snow in the midlands and south, stopped all work. Practically no other spring corn was got in anywhere, and field work is, upon the whole, rather backward. Vegetation was, however, generally very forward, and the snowy weather has given it a not unwelcome check, particularly in fruit-growing districts.

Seeds are nearly everywhere healthy and vigorous, promising very good crops, though here and there the recent weather has caused some damage.

The condition of ewes is generally average or satisfactory, and lambing prospects are good. In a few of the southern counties lambing is in full swing, and elsewhere it is beginning, except in hilly districts. The fall of lambs is stated nearly everywhere to be quite up to the average, and above it in some parts; and complaints of weak lambs or of unusual losses are relatively few; although fears are expressed that a continuance of the very bad weather may cause many deaths.

Outlying stock have only done poorly during the month, but the general condition of the animals is, nevertheless, satisfactory in view of the very trying conditions. The heavy snow caused stock to be housed again. Keep is getting rather scarce, especially hay and straw, although the amount on hand is very variable in different parts of the country, some districts having ample. The open weather which prevailed until the middle of February, giving plenty of grass feed in the open, was useful in saving a good deal of roots and fodder, and the general view is that there will be just sufficient to last for the remainder of the season.

Agricultural Labour in England and Wales during February.

ACCORDING to statements in the Board's *Monthly Agricultural Report* for 1st March, the supply of labour was everywhere very scarce and getting scarcer. Not very much was required during February as comparatively little work could be done, but many fears were expressed that there will not be enough help in the busy sowing season. The conditions in the different districts were as follows:—

Northumberland, Durham, Cumberland and Westmorland.—The supply of labour was very deficient, and the shortage was expected to be seriously felt as the spring advances.

Lancashire and Cheshire.—The labour supply was very short over the whole district, and it is anticipated that the difficulty will become aggravated as the spring advances and the demand increases with more favourable weather for spring sowing.

Yorkshire.—The supply of labour continues to decrease and is now very short generally. It is expected that spring sowing will be delayed in consequence.

Shropshire and Stafford.—Everywhere labour was scarce, and farmers were having difficulty in keeping the work going.

Derby, Nottingham, Leicester, and Rutland.—Labour was deficient or very short throughout the district.

Lincoln and Norfolk.—The supply of labour was practically everywhere very short, rather more so than last month.

Suffolk, Cambridge, and Huntingdonshire.—The supply of labour was everywhere short, but it was not much felt during February as little work was possible.

Bedford, Northampton, and Warwick.—Farm workers were very

Buckingham, Oxford, and Berkshire.—Labour was reported to be deficient in every district, and with drier weather the shortage will be more severely felt.

Worcester, Hereford, and Gloucester.—The supply of labour was everywhere very short, and wages still tend to rise.

Cornwall, Devon, and Somerset.—The supply of labour was everywhere deficient, and the shortage will be seriously felt with an improvement in the weather. It is anticipated that wages will rise at the Lady-day hirings.

Dorset, Wiltshire, and Hampshire.—The supply of labour was everywhere deficient, but the shortage has not yet been so severely felt owing to the bad weather preventing work upon the land. Wages have increased, and herdsmen, cowmen and shepherds are in demand.

Surry, Kent and Sussex.—Labour was very deficient, more especially among cattlemen and horsemen.

Essex, Hertford, and Middlesex.—The supply of labour was short throughout the district, and the scarcity will be more felt with an improvement in the weather.

North Wales.—Labour was scarce in practically every district.

Mid Wales.—Labour was very scarce in practically every part of the division.

South Wales.—The supply of labour was reported to be very short in most districts, and the outlook was considered to be very unsatisfactory.

Prevalence of Animal Diseases on the Continent.

The following statement shows that according to the information in the possession of the Board on 1st March, 1916, certain diseases of animals existed in the countries specified :—

Austria (on the 19th Jan.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Erysipelas, Swine Fever.

Denmark (month of Jan.).
Anthrax, Foot-and-Mouth Disease (223 outbreaks), Glanders and Farcy, Swine Erysipelas.

France (for the period 6th—19th Feb.).
Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders and Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Germany (for the period 1st—15th Jan.).
Foot-and-Mouth Disease, Glanders and Farcy, Swine Fever.

Holland (month of Jan.).
Anthrax, Foot-and-Mouth Disease (55 outbreaks), Foot-rot, Swine Erysipelas.

Hungary (on the 19th Jan.).
Foot-and-Mouth Disease, Glanders and Farcy, Sheep-pox, Swine Erysipelas, Swine Fever.

Italy (for the period 7th—13th Feb.).
Anthrax, Blackleg, Foot-and-Mouth Disease (1,946 outbreaks), Glanders and Farcy, Rabies, Sheep-scab, Swine Fever.

Norway (month of Jan.).
Anthrax, Swine Fever.

Rumania (for the period 14th—21st Dec.).
Anthrax, Blackleg, Foot-and-Mouth Disease, Glanders, Rabies Sheep-pox, Sheep-scab, Swine Fever.

Russia (month of Sept.).

Anthrax, Foot-and-Mouth Disease (299,922 animals), Glanders anc Farcy, Pleuro-pneumonia, Rabies, Sheep-pox, Swine Erysipelas, Swine Fever.

Spain (month of Nov.).

Anthrax, Blackleg, Dourine, Glanders, Pleuro-pneumonia, Rabies, Sheep-pox, Sheep-scab, Swine Erysipelas, Tuberculosis.

Sweden (month of Jan.).

Anthrax, Blackleg, Swine Erysipelas,

Switzerland (for the period 14th—20th Feb.).

Anthrax, Blackleg, Foot-and-Mouth Disease (36 "étables" entailing 420 animals, of which 2 "étables" were declared infected during the period), Rabies, Swine Fever.

No further returns have been received in respect of the following countries :—Belgium, Bulgaria, Montenegro, Serbia.

The Weather in England during February.

District.	Temperature.		Rainfall.				Bright Sunshine.	
	Daily Mean.	Diff. from Average.	Amount.		Diff. from Average.	No. of Days with Rain.	Daily Mean.	Diff. from Average.
	°F.	°F.	In.	Mm.*	Mm.*		Hours.	Hours.
Week ending Feb. 5th :								
England, N.E. ...	42·6	+3·4	0·38	10	+ 1	4	1·5	−0·6
England, E.	41·2	+2·3	0·38	9	− 1	4	1·1	−1·3
Midland Counties ...	42·1	+3·1	0·71	18	+ 5	3	1·5	−0·4
England, S.E.... ...	42·4	+2·0	0·84	21	+ 8	4	1·7	−0·3
England, N.W. ...	43·3	+3·4	1·00	25	+ 7	5	1·2	−0·5
England, S.W. ...	43·9	+2·3	1·53	39	+18	4	1·5	−0·6
English Channel ...	45·3	+0·9	0·85	22	+ 5	4	2·2	−0·3
Week ending Feb. 12th :								
England, N.E.... ...	38·7	0·0	0·60	15	+ 5	4	3·9	+1·5
England, E.	39·4	+0·9	0·53	13	+ 4	4	3·9	+1·4
Midland Counties ...	38·5	−0·2	0·72	18	+ 6	4	3·7	+1·5
England, S.E.... ...	40·8	+0·9	0·71	18	+ 5	5	3·8	+1·6
England, N.W. ...	39·9	+0·4	1·20	30	+14	6	2·3	+0·3
England, S.W. ...	41·2	0·0	1·41	36	+17	6	2·5	+0·2
English Channel ...	44·8	+0·7	1·71	43	+27	7	3·0	+0·2
Week ending Feb. 19th :								
England, N.E. ...	39·7	+1·3	0·62	16	+ 7	5	3·3	+0·6
England, E.	42·3	+4·5	1·06	27	+18	6	3·3	+0·5
Midland Counties ...	41·5	+2·1	1·13	29	+18	6	2·6	+0·2
England, S.E... ...	44·1	+4·3	1·19	30	+18	6	3·6	+0·9
England, N.W. ...	41·4	+1·8	1·44	37	+23	6	1·8	−0·6
England, S.W. ...	44·2	+3·2	1·84	47	+29	7	2·3	−0·3
English Channel ...	47·7	+3·8	1·32	34	+18	7	2·3	−0·9
Week ending Feb. 26th :								
England, N.E. ...	35·1	−3·4	0·75	19	+11	5	1·7	−1·0
England, E.	34·3	−4·1	1·06	27	+19	6	1·0	−1·9
Midland Counties ...	33·6	−4·9	0·77	19	+ 9	5	1·1	−1·4
England, S.E.... ...	34·3	−5·4	1·14	29	+18	5	1·5	−1·5
England, N.W. ...	36·0	−3·4	0·19	5	− 8	2	3·3	+0·4
England, S.W. ...	35·2	−5·8	0·83	21	+ 4	6	2·3	−0·6
English Channel ...	39·7	−4·3	1·73	44	+29	6	2·1	−1·5

* 1 inch = 25·4 millimetres.

DISEASES OF ANIMALS ACTS, 1894 to 1914.

NUMBER OF OUTBREAKS, and of ANIMALS Attacked or Slaughtered.

GREAT BRITAIN.

(From the Returns of the Board of Agriculture and Fisheries.)

DISEASE.	FEBRUARY.		TWO MONTHS ENDED FEBRUARY.	
	1916.	1915.	1916.	1915.
Anthrax:—				
Outbreaks	54	67	117	155
Animals attacked	63	75	128	175
Foot-and-Mouth Disease:—				
Outbreaks	1	—	1	—
Animals attacked	24	—	24	—
Glanders (including Farcy):—				
Outbreaks...	7	4	13	7
Animals attacked	20	6	44	11
Parasitic Mange:—				
Outbreaks	297	* —	787	* —
Animals attacked	655	* —	1,993	* —
Sheep-Scab:—				
Outbreaks	35	28	132	107
Swine Fever:—				
Outbreaks	319	284	704	691
Swine Slaughtered as diseased or exposed to infection	922	1,055	2,166	2,837

* The Parasitic Mange Order of 1911 was suspended from 6th August, 1914, to 27th March, 1915, inclusive.

IRELAND.

(From the Returns of the Department of Agriculture and Technical Instruction for Ireland.)

DISEASE.	FEBRUARY.		TWO MONTHS ENDED FEBRUARY.	
	1916.	1915.	1916.	1915.
Anthrax:—				
Outbreaks	—	—	1	—
Animals attacked	—	—	5	—
Foot-and-Mouth Disease:—				
Outbreaks	—	—	—	—
Animals attacked ...	—	—	—	—
Glanders (including Farcy):—				
Outbreaks	—	—	—	—
Animals attacked	—	—	—	—
Parasitic Mange:—				
Outbreaks	9	5	18	10
Sheep-Scab:—				
Outbreaks	57	62	142	131
Swine Fever:—				
Outbreaks	18	19	36	39
Swine Slaughtered as diseased or exposed to infection	68	149	105	248

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES of LIVE STOCK in ENGLAND and WALES in February and January, 1916.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	February. First Quality.	February. Second Quality.	January. First Quality.	January. Second Quality.
FAT STOCK :—	per stone.*	per stone.*	per stone.*	per stone.*
Cattle :—	s. d.	s. d.	s. d.	s. d.
Polled Scots	11 9	11 2	11 4	11 1
Herefords	11 8	10 7	11 2	10 2
Shorthorns	11 7	10 8	11 3	10 4
Devons	11 8	10 4	11 5	10 3
Welsh Runts	11 4	10 10	11 0	10 5
	per lb.*	per lb.*	per lb.*	per lb.*
	d.	d.	d.	d.
Veal Calves	—	9½	10	9
Sheep :—				
Downs	12¼	11¼	11¾	10½
Longwools	12	10¾	11	10
Cheviots	13¼	12	11¾	10¾
Blackfaced	13	11½	11½	10¼
Welsh	11¾	10¾	10¼	9½
Cross-breds	12¾	11½	11½	10½
	per stone.*	per stone.*	per stone.*	per stone.*
Pigs :—	s. d.	s. d.	s. d.	s. d.
Bacon Pigs	11 1	10 4	10 7	9 11
Porkers	11 11	11 3	11 6	10 10
LEAN STOCK :—	per head.	per head.	per head.	per head.
Milking Cows :—	£ s.	£ s.	£ s.	£ s.
Shorthorns—In Milk ...	29 14	24 3	29 12	24 2
,, —Calvers ...	29 7	23 19	29 1	23 0
Other Breeds—In Milk ...	27 4	23 6	28 0	24 2
,, —Calvers ...	—	20 0	21 10	19 10
Calves for Rearing	2 17	2 4	2 15	2 2
Store Cattle :—				
Shorthorns—Yearlings ...	13 6	11 7	12 15	10 16
,, —Two-year-olds...	17 18	16 4	17 5	15 3
,, —Three-year-olds	23 18	20 14	22 14	19 7
Herefords —Two-year-olds...	20 1	16 11	19 0	15 7
Devons— ,,	18 17	16 11	18 4	16 0
Welsh Runts— ,,	18 15	17 5	17 7	—
Store Sheep :—				
Hoggs, Hoggets, Tegs, and Lambs—	s. d.	s. d.	s. d.	s. d.
Downs or Longwools ...	58 6	51 1	53 6	45 7
Store Pigs :—				
8 to 12 weeks old	26 11	20 1	25 8	18 9
12 to 16 weeks old	46 5	35 10	44 7	34 4

* Estimated carcass weight.

AVERAGE PRICES of DEAD MEAT at certain MARKETS in ENGLAND in February, 1916.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	Birmingham.		Leeds.		Liverpool.		London.		Manchester.	
		per cwt.		per cwt.		per cwt.		per cwt.		per cwt.	
		s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
BEEF :—											
English	1st	77	0	76	0	—		78	6	74	6
	2nd	71	6	73	0	—		74	0	71	0
Cow and Bull	1st	70	0	71	0	66	6	69	0	69	6
	2nd	65	6	66	0	59	6	64	0	64	6
Irish: Port Killed	1st	73	0	73	0	73	6	76	0	72	6
	2nd	70	0	71	6	69	0	72	0	67	6
Argentine Frozen—											
Hind Quarters	1st	67	6	73	6	70	0	—		70	0
Fore "	1st	58	6	58	6	60	6	—		60	6
Argentine Chilled—											
Hind Quarters	1st	75	6	72	6	72	6	74	6	73	6
Fore "	1st	61	0	60	6	62	0	61	0	62	0
Australian Frozen—											
Hind Quarters	1st	64	6	—		69	0	—		69	0
Fore "	1st	55	0	—		60	6	—		60	6
VEAL :—											
British	1st	—		—		—		106	0	—	
	2nd	92	0	—		—		97	0	—	
Foreign...	1st	—		—		—		111	0	—	
MUTTON :—											
Scotch	1st	96	0	97	0	106	0	104	0	105	6
	2nd	94	0	93	6	98	0	95	6	101	6
English...	1st	95	0	98	6	—		93	6	101	0
	2nd	91	6	94	0	—		88	0	97	0
Irish: Port Killed	1st	91	6	—		96	0	88	6	97	6
	2nd	89	6	—		88	0	84	0	92	6
Argentine Frozen	1st	72	6	71	0	70	6	71	6	70	6
Australian "	1st	69	6	70	0	70	0	68	6	70	0
New Zealand "	1st	71	0	72	6	—		73	0	—	
LAMB :—											
British	1st	116	6	—		—		115	6	—	
	2nd	107	6	—		—		106	0	—	
New Zealand	1st	79	6	77	6	79	6	78	6	79	6
Australian	1st	76	6	—		77	0	76	0	77	0
Argentine	1st	74	0	76	0	76	6	76	0	76	6
PORK :—											
British	1st	102	0	93	6	104	6	101	0	97	6
	2nd	96	0	89	0	95	6	91	6	93	6
Frozen	1st	74	6	75	0	80	6	74	6	77	0

AVERAGE PRICES of PROVISIONS, POTATOES, and HAY at certain MARKETS in ENGLAND in February, 1916.

(*Compiled from Reports received from the Board's Market Reporters.*)

Description.	Bristol.		Liverpool.		London.	
	First Quality.	Second Quality.	First Quality.	Second Quality.	First Quality.	Second Quality.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
BUTTER:—	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.	per 12 lb.
British	19 0	18 0	—	—	19 0	18 3
	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.	per cwt.
Irish Creamery—Fresh	—	—	—	—	—	—
„ Factory	131 0	123 6	128 0	119 6	—	—
Danish...	—	—	164 6	162 0	161 6	158 6
French...	—	—	—	—	159 6	153 6
Russian	127 6	121 0	—	122 0	130 0	122 0
Canadian...	150 0	146 0	150 0	146 0	—	—
Australian	152 6	148 6	151 6	147 6	159 0	151 6
New Zealand	156 6	154 6	156 0	154 0	162 0	154 6
Argentine	150 6	146 6	148 6	145 6	152 6	146 6
CHEESE:—						
British—						
Cheddar	107 0	99 6	108 0	104 6	107 6	101 6
			120 lb.	120 lb.	120 lb.	120 lb.
Cheshire	—	—	122 0	117 6	123 6	116 0
			per cwt.	per cwt.	per cwt.	per cwt.
Canadian	101 6	97 6	101 6	97 0	100 0	98 0
BACON:—						
Irish (Green)	106 0	101 6	104 6	100 6	106 0	100 6
Canadian (Green sides)	92 0	87 6	92 0	86 0	94 6	88 6
HAMS:—						
York (Dried or Smoked)	148 6	140 6	—	—	150 6	141 0
Irish (Dried or Smoked)	—	—	—	—	142 0	136 0
American (Green) (long cut)	84 6	81 0	86 6	81 6	88 0	84 0
EGGS:—	per 120.	per 120.	per 120.	per 120.	per 120.	per 120.
British...	17 8	—	—	—	18 4	17 1
Irish	17 1	—	16 10	15 11	17 6	16 7
American	11 4	—	10 6	9 6	11 3	10 3
POTATOES:—	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
British Queen ...	98 6	85 0	—	—	106 0	97 6
Edward VII.	108 0	98 0	76 6	73 6	102 6	95 6
Up-to-date	98 0	90 0	70 0	65 0	100 0	91 6
HAY:—						
Clover...	—	—	166 0	130 0	136 0	128 6
Meadow	—	—	—	—	132 0	123 0

AVERAGE PRICES of **British Corn** per Quarter of 8 Imperial Bushels, computed from the Returns received under the Corn Returns Act, 1882, in each Week in 1914, 1915 and 1916.

Weeks ended (*in* 1916).	Wheat. 1914.	Wheat. 1915.	Wheat. 1916.	Barley. 1914.	Barley. 1915.	Barley. 1916.	Oats. 1914.	Oats. 1915.	Oats. 1916.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Jan. 8...	30 11	46 2	55 8	25 11	29 7	47 8	18 4	26 5	31 5
,, 15...	31 0	48 9	56 7	26 0	30 5	48 6	18 6	27 6	31 11
,, 22...	30 11	51 6	57 2	26 3	31 3	49 6	18 11	28 10	32 6
,, 29...	31 1	52 8	58 0	26 6	32 5	51 0	19 1	29 10	32 11
Feb. 5...	31 0	53 3	58 3	26 7	33 7	52 5	18 9	30 3	32 4
,, 12...	31 0	54 8	57 6	26 7	34 7	52 10	18 11	31 1	32 2
,, 19...	31 0	56 0	56 11	26 7	34 11	53 6	18 11	31 5	31 9
,, 26...	31 0	56 0	58 2	26 6	35 3	54 2	18 11	31 8	32 2
Mar. 4...	31 5	55 11	59 4	26 2	34 6	55 7	18 9	31 8	32 4
,, 11...	31 6	54 8	58 2	26 0	33 5	55 6	18 7	31 0	32 3
,, 18...	31 5	53 9		25 8	32 2		18 6	30 7	
,, 25...	31 4	54 3		25 7	31 11		18 8	30 6	
Apl. 1...	31 6	54 6		25 6	31 9		18 5	30 6	
,, 8...	31 5	54 9		26 8	31 3		18 4	30 4	
,, 15...	31 7	55 4		25 4	30 10		18 4	30 5	
,, 22...	31 9	56 5		26 6	31 5		18 5	30 11	
,, 29...	31 9	58 3		26 0	32 7		18 5	31 5	
May 6...	32 2	60 5		25 6	33 3		18 9	32 4	
,, 13...	32 7	61 7		26 3	34 0		18 11	32 5	
,, 20...	33 0	62 0		25 10	34 1		19 0	32 8	
,, 27...	33 9	61 11		26 1	34 8		19 4	32 7	
June 3...	34 0	61 9		25 11	35 4		19 4	32 5	
,, 10...	34 1	60 1		24 11	34 5		19 8	32 4	
,, 17...	34 1	56 1		25 10	34 3		19 9	31 9	
,, 24...	34 3	52 0		25 4	34 4		20 0	31 9	
July 1...	34 4	49 5		24 6	35 3		19 9	31 1	
,, 8...	34 2	50 1		24 9	34 7		20 0	31 6	
,, 15...	34 1	52 7		24 2	35 8		19 10	31 6	
,, 22...	34 0	53 10		24 7	35 10		19 9	32 1	
,, 29...	34 2	55 3		25 9	36 1		19 8	31 1	
Aug. 5...	34 9	55 4		25 2	35 7		19 1	31 5	
,, 12...	40 3	55 2		29 4	37 0		25 1	31 7	
,, 19...	38 9	54 3		29 10	39 4		24 3	31 4	
,, 26...	36 2	51 11		30 3	38 3		23 5	30 0	
Sept. 2...	36 5	45 3		30 6	38 1		23 9	26 10	
,, 9...	37 10	43 0		29 11	37 11		23 11	26 8	
,, 16...	38 3	42 9		29 5	39 0		23 8	26 4	
,, 23...	37 6	43 3		29 3	39 8		23 3	26 1	
,, 30...	37 1	43 5		29 1	40 4		22 9	26 5	
Oct. 7...	36 8	44 1		28 10	41 0		22 5	26 5	
,, 14...	36 7	45 9		28 8	42 3		22 4	27 1	
,, 21...	37 2	48 2		28 7	44 0		22 5	28 1	
,, 28...	37 10	50 3		28 3	46 2		23 7	29 1	
Nov. 4...	38 8	51 6		28 6	47 3		23 7	30 4	
,, 11...	39 8	52 8		29 0	47 5		24 8	30 11	
,, 18...	41 0	53 6		29 8	47 11		25 5	31 3	
,, 25...	41 11	54 2		30 3	48 7		25 8	31 1	
Dec. 2...	42 2	53 7		30 2	48 11		25 9	30 11	
,, 9...	42 1	52 10		29 11	47 10		25 9	30 4	
,, 16...	42 7	53 11		29 8	47 5		25 9	30 6	
,, 23...	43 3	53 10		29 9	47 2		25 11	30 7	
,, 30...	44 4	54 9		29 10	47 5		26 6	30 10	

NOTE.—Returns of purchases by weight or weighed measure are converted to Imperial Bushels at the following rates: Wheat, 60 lb.; Barley, 50 lb.; Oats, 39 lb. per Imperial Bushel.

AVERAGE PRICES of **British Wheat, Barley, and Oats** at certain Markets during the Month of February, 1914, 1915, and 1916.

—	Wheat.						Barley.						Oats.					
	1914.		*1915.*		*1916.*		*1914.*		*1915.*		*1916.*		*1914.*		*1915.*		*1916.*	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
London ...	32	2	57	1	58	11	26	8	35	0	52	2	20	1	32	7	33	6
Norwich ...	30	8	54	3	56	1	26	0	34	8	53	1	18	11	31	7	31	6
Peterborough	30	4	55	1	56	11	25	11	35	1	52	2	18	7	31	2	31	11
Lincoln ...	31	1	55	0	58	5	27	1	34	10	52	9	19	5	30	9	31	6
Doncaster ...	31	2	53	10	58	5	26	9	33	4	53	4	19	2	29	8	31	11
Salisbury ...	30	3	54	0	57	4	25	4	35	3	54	4	19	0	33	4	32	9

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

Rome, International Institute of Agriculture.—The International Movement of Fertilisers, No. 3, September, 1915. Rome, 1915. Fr. 1.50 [63.1621.]

Lambert, T.—Bone Products and Manures: An Account of the most recent Improvements in the Manufacture of Fat, Glue, Animal Charcoal, Size, Gelatine, and Manures. (167 pp.) London: Scott, Greenwood & Son, 1913. 7*s.* 6*d.* net. [664.3; 63.1621.]

India, Imperial Department of Agriculture.—Memoirs. Chemical Series, Vol. IV., No. 3:—Soil Gases. (85–134 pp.) Calcutta, 1915. 2*s* 6*d.* [63.113.]

Canada, Department of Agriculture.—Circ. 7:—Potash in Agriculture. (8 pp.) Ottawa, 1914. [63.1673.]

"*Pat.*"—My Little Farm. (212 pp.) Dublin and London: Maunsel & Co., 1915. 3*s.* 6*d.* net. [63 (415).]

Russell, E. J.—A Students' Book on Soils and Manures. (206 pp.) Cambridge: University Press, 1915. 3*s.* 6*d.* net. [63.11 (02); 63.16 (02).]

Board of Education.—Educational Pamphlet 31:—A Rural Special Subjects Centre. (9 pp.) London: Wyman & Sons, 1915. 1*d.* [371.]

Agricultural Relief of Allies Committee.—The Ruined Homesteads of France: Report of a Delegation to Champagne and Lorraine. (30 pp.) London: 16, Bedford Square, W.C. 3*d.* [63 (44).]

U.S. Department of Agriculture.—Bull. 312:—Phosphate Rock and Methods Proposed for its Utilisation as a Fertiliser. (37 pp.) Washington, 1915. [63.1672.]

Pennsylvania, Department of Agriculture.—Bull. 261:—Sour Soils and Liming. (221 pp.) Harrisburg, Pa., 1915. [63.15.]

Mississippi Agricultural Experiment Station.—Bull. 168:—Bacteriological Effects of Green Manures. (20 pp.) Agricultural College, Mississippi, 1915. [576.83.]

Board of Education.—Educational Pamphlet 29:—Educational Experiments in Secondary Schools, No. IV.:—The Experiment in Rural Secondary Education conducted at Knaresborough. (26 pp.) London: Wyman & Sons, 1915. 4*d.* [373.]

Maryland Agricultural Experiment Station.—Bull. 191:—Relation of Catalase and Oxidases to Respiration in Plants. (16 pp.) College

Field Crops—

India, Imperial Department of Agriculture.—Memoirs. Botanical Series. Vol. VII., No. 8:—The Inheritance of some Characters in Wheat. II. (273–285 pp., + viii. plates.) Calcutta, 1915. 2s. 6d. [63.311 (04).]

Wren, R. C.—Potter's Cyclopædia of Botanical Drugs and Preparations. (339 pp.) London: Potter & Clarke, n.d. 3s. 6d. [63.348.]

Edinburgh and East of Scotland College of Agriculture.—Varieties of Oats and Barley. (10 pp.) Edinburgh [1915]. [63.314; 63.313.]

Gras, N. S. B.—The Evolution of the English Corn Market from the XIIth to the XVIIIth century. (498 pp.) Cambridge (U.S.A.): Harvard University Press; London: Oxford University Press, 1915. 10s. 6d. net. [63.31 : 38.]

Salop County Council.—Report on Wheat Varieties, 1915 (7 pp.) Shrewsbury, 1915. [63.311 (04).]

Dorset County Council, Education Committee.—Agricultural Leaflet No. 2: Potato Experiments, 1915. (7 pp.) Dorchester: County Offices, 1915. [63.512 (04).]

Mauritius, Department of Agriculture.—General Series, Bull. 5:—The Fibre Industry of Mauritius. (15 pp.) Port Louis, Mauritius, 1915. [63.341.]

Oklahoma Agricultural Experiment Station.—Bull. 103:—Sudan Grass. (14 pp.) Stillwater, Ok., 1915. [63.33 (d).]

U.S. Department of Agriculture.—Bull. 316:—Willows: Their Growth, Use, and Importance. (52 pp.) Washington, 1915. [63.3412.]

U.S. Department of Agriculture.—Farmers' Bull. 693:—Bur Clover. (14 pp.) Washington, 1915. [63.33(b).]

Horticulture—

Stebbins, C. A.—The Principles of Agriculture through the School and the Home Garden. (380 pp.) New York and London: The Macmillan Company, 1915. 4s. 6d. net. [63.5(07).]

Oregon Agricultural Experiment Station.—Bull. 124:—Comparative Cooking Qualities of some of the Common Varieties of Apples grown in Oregon. (36 pp.) Corvallis, Oregon, 1915. [63.41(a).]

New Mexico Agricultural Experiment Station.—Bull. 89:—Hardiness of Fruit Buds and Flowers to Frost. (52 pp.) State College, New Mexico, 1914. [63.41(04).]

Plant Diseases—

Sander, A.—Deutschlands Kampf mit dem Kartoffelkafer—(*Chrysomela (Doryphora) decemlineata*). (46 pp.) M. Gladbach: Volksverein-Verlag, 1914. 60 pf. [63.27.]

Wisconsin Agricultural Experiment Station.—Research Bull. 37:—Germination and Infection with the Fungus of the Late Blight of Potato. (*Phytophthora infestans*) (64 pp.) [63.24.] Research Bull 38:—The Control of Cabbage Yellows [caused by *Fusarium conglutinans*] through Disease Resistance. (70 pp.) [63.24.] Madison, Wis., 1915.

Virginia Truck Experiment Station.—Bull. 14:—Control of the Colorado Potato Beetle (*Leptinotarsa decemlineata*, Say.). (315–333 pp.) Norfolk, Va., 1915. [63.27.]

West Virginia Agricultural Experiment Station.—Bull. 154:—Apple Rust.—(73 pp.) Morgantown, West Virginia, 1915. [63.24.]

Live Stock—

Edinburgh and East of Scotland College of Agriculture.—Report Leaflet, Series C. No. 1:—Cattle Feeding Experiment, 1914–15. (4 pp.) Edinburgh, 1915. [63.62.]

Malden, W. J.—British Sheep and Shepherding. (239 pp.) London: Macdonald & Martin [1915]. 6s. net. [63.63(02).]

West of Scotland Agricultural College.—Bull. 67:—Report on Cattle Feeding Experiments conducted at Crichton Farm, Dumfries, 1911–15. (25–42 pp.) Bull. 68:—Report on Cattle Feeding Experiments conducted at the College Farm in 1914 and 1915. (45–60 pp.) Glasgow, 1916. [63.62.]

British Columbia, Department of Agriculture.—Bull. 64:—Angora and Milch Goats. (37 pp.) Victoria, B.C., 1915. [63.63.]

Wisconsin Agricultural Experiment Station.—Research Bull. 36:—Acidosis in Omnivora and Herbivora and its Relation to Protein Storage. (19 pp.) Madison, Wis., 1915. [612.394.]

U.S. Department of Agriculture.—Bull. 313:—Features of the Sheep Industries of United States, New Zealand, and Australia compared. (35 pp.) Washington, 1915. [63.6(73); 63.6(9).]

Dairying and Food, General—

Lauder, A. and *Fagan, T. W.*—On the Composition of Milk as affected by Increase of the Amount of Calcium Phosphate in the Rations of Cows. (195–202 pp.) [Proc. Roy. Soc. Edinburgh, Vol. XXXV., Pt. II., No. 19], 1915. 6*d.* [63.712; 63.711(a).]

Wye, South-Eastern Agricultural College.—Fourth Report on the Cost of Food in the Production of Milk in the Counties of Kent and Surrey. (95 pp.) Wye, 1915. Residents, 1*s*; Non-residents, 2*s.* [63.711; 63.714.]

West Sussex Milk Recording Society.—Report on Milk Yields and Cost of Food. (22 pp.) Chichester, 1915. [63.711(b); 63.714.]

Veterinary Science—

U.S. Department of Agriculture.—Farmers' Bull. 666:—Foot-and-Mouth Disease. (16 pp.) Washington, 1915. [619.2(d).]

Edinburgh and East of Scotland College of Agriculture.—Pathology and Epidemiology of Swine Fever. (40 pp.) Edinburgh, 1915. [619.4(a).]

Edinburgh and East of Scotland College of Agriculture.—Epidemiology and Pathology of Chicken Cholera. (26 pp.) Edinburgh, 1915. [619.5(a).]

Edinburgh and East of Scotland College of Agriculture.—Investigation into "Louping-ill" or "Trembling." (51 pp.) Edinburgh, 1915. [619.3(c).]

Belgium, Ministère des Colonies, Service de l'Agriculture.—Études de Biologie Agricole, No. I.:—Notice sur les Glossines ou Tsétsés. (148 pp.) London: Hutchinson & Co. n.d. [59.169(a).]

Craig, R. A.—Common Diseases of Farm Animals. (334 pp.) Philadelphia and London: J. B. Lippincott Company, 1915. $1.50 net. [619(02).]

Nuttall, G. H. F. and *Warburton, C.*—Ticks: A Monograph of the Ixodoidea. Part III. The Genus Haemaphysalis. (349–550 pp. + plates VIII–XIII.) Cambridge: University Press, 1915. 12*s.* net. [59.169(b).]

U.S. Department of Agriculture.—Bull. 340:—Experiments in Vaccination against Anthrax. (10 pp.) Washington, 1915. [619.2(b).]

Birds, Poultry, and Bees—

Brown, E.—Poultry Husbandry. (416 pp.) London: E. Arnold, 1915. 8*s.* 6*d.* net. [63.65(02).]

Broomhead, W. W.—Egg Production on the Intensive System. (81 pp.) London: "Poultry" Offices, 1915. 1*s.* [63.651(04).]

Powell-Owen, W.—Poultry-keeping on Money-making Lines. (228 pp.) London: G. Newnes, 1916. 2*s.* 6*d.* net. [63.65(02).]

Massachusetts Agricultural Experiment Station.—Bull. 163:—Bacillary White Diarrhœa (*Bacterium Pullorum* Infection) in Young Chicks in Massachusetts. (48 pp.) Amherst, Mass., 1915. [619.5.]

Nevada Agricultural Experiment Station.—Bull. 82:—The Control of Contagious Epithelioma in Chickens by Vaccination. (16 pp.) Reno, Nevada, 1915. [619.5.]

Engineering—

U.S. Department of Agriculture.—Bull. 304:—Land Drainage by means of Pumps. (59 pp.) Washington, 1915. [63.14.]

U.S. Department of Agriculture.—Farmers' Bull. 698:—Trenching Machinery used for the Construction of Trenches for Tile Drains. (26 pp.) Washington, 1915. [63.14.]

Economics—

U.S. Department of Agriculture, Office of the Secretary.—Circ. 53:—Formulæ for Calculating Interest on Farm Equipment. (4 pp.) Washington, 1915. [338.58; 657.]

Pilkington, Col. H.—Land Settlement for Soldiers. (101 pp.) London: William Clowes & Sons, 1911. 2*s.* [331; 325.]

Turnor, C.—Land Settlement after the War. (101–120 pp.) [Jour. Farmers' Club, December, 1915.] London, 1915. 6*d.* [331.]

Wisconsin Agricultural Experiment Station.—Research Bull. 34:—The Social Anatomy of an Agricultural Community. (34 pp.) Madison, Wis., 1915. [338.1.]

(4336.) P. 16—9. 7,250. 3/16. J. T. & S., Ltd.

INDEX TO VOL. XXII.

(APRIL, 1915, TO MARCH, 1916.)

NOTE.—References to Insects, &c., and Fungi are indexed under the headings "Insects, &c.," and "Fungi" only, to Weeds under the heading "Weeds" only, to Fruit under the heading "Fruit" only, to Diseases of Animals under the heading "Diseases of Animals" only, and to Import and Export Regulations under the heading "Import and Export Regulations" only.

References to matters connected with the effect of the War on Agriculture are indexed under the heading "War and Agriculture."]

The names of the research and experiment stations at which the experiments summarised in the *Journal* have been conducted are indicated in italics, thus:—(*Rothamsted*). In the case of experiments conducted abroad, the name of the country is given.

Articles or reports on the following subjects appear in the *Journal* each month, or from time to time, and are not separately indexed:—Unit Prices of Artificial Manures, Notes on Crop Prospects and Live Stock Abroad, Notes on the Weather, Notes on Agricultural Labour in England and Wales, Notes on Agricultural Conditions in England and Wales, Prices of Agricultural Produce, Outbreaks under the Diseases of Animals Acts, Prevalence of Animal Diseases on the Continent, Lists of Additions to the Board's Library, and Selected Contents of Periodicals.

PAGE

Acorns, bad effect on laying hens (*Germany*) 902
,, feeding to live stock 686
Afforestation, see *Forestry*.
Agricultural Organisation Society, Development Commissioners' report for 1914–15 on grant 1175
Agricultural research, see *Research*.
Agricultural returns and statistics (see also *Crops, Live Stock, Labour*, and *Prices*):
Area under crops in England and Wales, 1914 (Part I., 1914) ... 475
,, ,, ,, ,, 1915 596
,, ,, in the United Kingdom 90, 506, 701, 1189
Corn prices, annual averages, 1909–1915 1037
,, pulse and hay crops, acreage and produce in 1915 817
Exports in 1915 1160
Grain, imports in the cereal year, 1914–15 579
Hops, acreage in 1915 595
,, produce in 1915 816
Imports of agricultural produce 514, 519, 579, 986
Index number 911
International Institute of Agriculture:
Bulletin of agricultural and commercial statistics 377
Third year-book of agricultural statistics 815
Live stock, numbers in England and Wales, 1915 597
,, ,, the United Kingdom ... 90, 509, 701, 1189
Potato crops, acreage and *yield* in 1915 910
Prices and supplies of agricultural produce in 1914 ... ... 511, 906
Produce of crops in England and Wales, 1914 373
,, ,, in the United Kingdom 90, 509, 1189
Root crops, acreage and yield in 1915 910
Ireland, area under crops and number of live stock, 1915 466
Scotland, area under crops and number of live stock, 1915 ... 467
Allotments, see *Small Holdings* and *Allotments*.
Amos, A.: The failure of a crop of barley 313
Animals Division of the Board, report for 1914 87
Apples, see *Fruit*.
Army, see *War and Agriculture*.
Ashby, A. W.: Suggestions from America for co-operative selling ... 201, 370
Ashes, see *Manures*.
Atmospheric impurities and plant growth (*Leeds*) 168
Australian meat export trade, report of commission of enquiry ... 460

PAGE
Bacon, cause of black discoloration (*Cambridge*) 1304
,, Hitchin factory 317
Bacteriology: Colon bacilli, ability to survive pasteurisation (*U.S.*) ... 268
Condensing and drying of milk, effect on bacterial content ... 267
Eggs, bacterial content (*U.S.*) 167
Electricity, destruction of milk bacteria by 1229
Peat, bacterised, as manure (*Midland*) 1297
,, inoculation of crops with (*Woburn*) 464
Serum injection for treatment of swine fever 594, 691, 702
Sterilisation of soil by steaming (*U.S.*) 807
,, ,, partial, by antiseptics 158
,, ,, ,, with lime 255
South Africa, inoculation of cattle in Rhodesia against the plasmoses 476
Barker, B. T. P.: *Disorders of cider and perry* 939
Summer sprays against American gooseberry-mildew 1244
The use of pressed apple pomace 851
Barley (see also *Corn* and *Crops*): Acreage and Produce in 1914 ... 90
,, ,, ,, ,, 1915 701, 817, 1189
Failure of a barley crop, description and reasons 313
Green manuring (*Rothamsted*) 355
Growth after leguminous crops (*Rothamsted*) 356
Growth of two white straw crops in succession 533
Malt culms, use as a feeding stuff 239, 302
Manuring (*Northants C. C.*) 70
,, in spring of 1916 1275
Prices of British barley, averages 581, 1037
Rate of seeding (*Harper Adams*) 262
Varieties (*Chelmsford*) 69
,, (*Edinburgh*) 1011
,, (*Harper Adams*) 262
,, (*Ireland*) 69
,, (*Woburn*) 898
Basic slag, see *Manures*.
Basket-making 1089
Bathurst, Capt. C., speech at food supply meeting 501
Beans (see also *Soya Beans*): Acreage and Produce in 1914 90
,, ,, ,, 1915 ... ...817, 1189
Growth 29
Manuring 1271
Use as a feeding stuff 305
Beef, see *Meat*.
Beet, see *Sugar Beet*.
Bees, pollination of fruit trees by 419
Belgium: Poultry keeping at Lippeloo 329
Berry, G. P.: *Notes on lime washes* 1125
Berry, R. A.: *Composition of wood and plant ash* 766
Biffen, R. H.: *Report on an enquiry into the quality of farm seeds, 1912-14* 1041
The selection of wheats for spring sowing 867
Birds: Harmful birds, methods of combating and destruction ... 1164
Pigeon breeding for utility purposes 335
Woodpeckers, and their relation to forestry 789
Board of Agriculture and Fisheries (see also *War and Agriculture*):
Agricultural consultative committee 178
Agricultural returns and statistics, see *Agricultural Returns*.
Allotments, President's circular letter as to increase of food production 1011
Allotments, report on, 1914 281
American gooseberry mildew orders of 1915 ... ... 276, 279
,, ,, warning 177
Animals Division, report for 1914 87
Canadian cattle, deputation as to importation 590
Chief veterinary officer's report for 1914 ... ... 700, 704
Commercial Control Branch, reports for 1914 and 1915 ... 374, 1259
Common, grazing in 1291
Demonstrations of motor ploughs and tractors 760
Development Fund grants, see *Development Fund*.
Education, see *Education*.

Board of Agriculture and Fisheries—*continued.* PAGE
Eggs, description as fresh and new laid 590
Fertilisers and Feeding Stuffs Act, 1906, facilities for sampling and analysis 702
Fertilisers, committee to control supplies 811, 1015, 1180
Food supply meeting, Lord Selborne's and other speeches... ... 489
Foot-and-mouth disease outbreaks 814, 910, 1021, 1179, 1308
Grain, purchase by Government 1013
Home-grown timber committee 1019
Home production of food, circular letters as to need for increase ...816, 1186
,, ,, committees on 370, 494, 585, 803
Horses, see *Live Stock—Horses.*
Horticulture Branch, report for 1914–15 931
Indian Wheat Committee 180, 372
International Institute of Agriculture: Monographs on Agricultural Co-operation; Vol. II., sale by the Board 370
Third year-book of agricultural statistics, sale by the Board ... 815
Journal supplement: Report on the poultry industry in Wales ... 694
Kew Gardens, charges for admission 1019
Labour, measures suggested and adopted to deal with shortage, see *Labour* and *War and Agriculture.*
Land settlement for discharged soldiers and sailors, committee to consider 469, 813, 1166, 1188
Leaflets in 1915 ... ...373, 1020
,, issue of third bound volume 1021
,, special 87, 468, 698, 1020
Live Stock, see *Live Stock.*
Maintenance of Live Stock Act, 1915 468
,, ,, Order, 1915... ... ...591, 1018
Military Service Act, 1916, notice to farmers 1181
Milk records certificate, value... 1292
National Insurance Act, 1911, regulations 700
Parasitic mange amongst cast army horses, circular letter... ... 700
Poultry keeping, local restrictions under Public Health Act, 1875 ... 1021
Poultry, scheme for distributing sittings of eggs of pure breeds ... 812
Rabies in an imported dog 177
Sale of Food and Drugs Acts, circular letter as to hardship in sale of milk 908
Selborne, Lord, appeal to farmers in England and Wales 670
Slaughter of animals... ... ... 182, 370, 468, 469, 702
Small holdings, annual report, 1914 73
Special Enquiries Branch, report for first 12 months of war ... 833
Sulphate of ammonia, need for increased purchase by farmers 1180, 1267, 1309
,, ,, Parliamentary Secretary's letter to "Times" as to exportations 1016
Swine fever, Board's scheme for treatment by serum injection 594, 691, 702
,, final report of committee 690
,, slaughter of pigs 702
Tithe, etc., Acts, report of proceedings under, 1914 281
,, maps, alteration in facilities for examination 1019
Transport of goods by rail 811
Walker, Colonel Hall, purchase of stud by the Government ... 911
War agricultural committees 702, 861, 907, 1013, 1015, 1186
War notices, etc., see *War and Agriculture.*
Wart disease of potatoes, suitable varieties for infected areas ... 813
Board of Trade:
Agricultural labourers and enlistment 87
Labour Exchanges and the war 178, 179
Wages of agricultural labourers, increase in 374
Women, notices as to war work 472, 474
Bog land, reclamation by manuring and crop growing (*Ireland*) ... 897
Book-keeping, methods of farm valuation 1215
Bordeaux Mixture, see *Spraying.*
Botanic gardens, Kew, charges for admission 1019
Bracken, use as litter 689, 699
Bran, use for feeding purposes 299, 1132, 1301
Brazil: Agriculture and live stock in 1295
Bread making from buckwheat 1131
,, ,, rice flour (*France*) 465

Breeding (see also *Live Stock*) : PAGE
Black currants and pears, experiments in crossing 252
Foundling variety of hop 136
Hereditary twinship in sheep (*U.S.*) 1178
Pollination of fruit trees 418
Sheep crossing experiment (*Harper Adams*) 163
Brewers' grains, use for feeding purposes 300, 301, 1301
British Association (see also specific subjects of papers read) :
Presidential address on food supplies in time of war 504
Systems of farming and the need for more tillage 520
British Columbia, see *Canada*.
British Flax and Hemp Growers' Society, Limited : Linseed as a farm crop 1069
Brooks, F. T. : Experiments on American gooseberry mildew in Cambridgeshire 227
Brown, E. : Combination in poultry-keeping 326
Laying competition at Burnley 658
Report on the poultry industry in Wales, *Journal supplement* ... 694
"Brown Oak," a disease of oak trees 902
Buckwheat, growth, composition and uses 28, 1128
Burgundy mixture, see *Spraying*.
Burnley egg-laying competition 658
Butter, see *Dairying*.

Cabbages, manuring 1272
,, time of sowing (*Chelmsford*) 266
Calcium carbide residue for liming 699, 1289
Calcium cyanamide, see *Manures*.
Calico poultry-houses 969, 1140
Cambridge University : Monthly notes on feeding stuffs 52, 148, 248, 322, 456, 574, 680, 792, 887, 1001, 1149, 1276
Use of straw for fodder 663
Campbell, Colin, speech at food supply meeting 503
Canada : Agricultural budget for 1915–16 377
,, credit in British Columbia 274
Deputation to the Board as to importation of Canadian cattle ... 590
Medicinal plants, cultivation 913
Weed control acts and methods 184
Carriage by rail of agricultural produce 177, 781, 811, 1260
Castor oil seeds, poisoning of stock by (*Germany*) 359
Cattle, see *Live Stock*.
Cereals, see *Corn* and specific crops.
Chalk, see *Lime*.
Cheese, see *Dairying*.
Chickens, see *Poultry*.
Cider, see *Fruit—Apples*.
Clover : Clustered clover seed as an adulterant of white clover seed ... 253
Crimson clover, growth 30
Leys, improvement by increased sowing of clover 1110
Manuring (*E. Suffolk, C. C.*) 162
Mixtures of clover and grass seed 356, 997
Quality of seed of red, white and alsike clover, 1912–1914 ... 1044
White clover seed, adulteration 253, 997
Wild white clover 1063
Cocksfoot, report on quality of seed, 1912–1914 1050
Coco-nut cake, use as a feeding stuff 304, 740
Collinge, W. E. : A preliminary report upon the economic status of the British species of woodpeckers and their relation to forestry ... 789
Collins, S. H. : The feeding of linseed to calves 120
Commercial Control Branch of the Board, reports for 1914 and 1915 374, 1259
Commissions and Committees :
Agricultural consultative committee 178
Development Commission, see *Development Fund*.
Fertilisers, committee to control supplies 811, 1015, 1160
Home-grown timber committee 1019
Home production of food, committees on 370, 494, 585, 803
es, committee on supply for military purposes ... 590, 1022, 1253
ın wheat committee 180, 372
ar committees to deal with shortage 179
l settlement for discharged soldiors and sailors, committee to nsider 469, 813, 1166, 1168

Commissions and Committees—*continued.* PAGE
Sewage disposal, final report ... 235
Swine fever, final report of committee ... 690
War agricultural committees ... 702, 861, 907, 1013, 1015, 1186
Australia, export of meat commission, report ... 460
Common, grazing in ... 1291
Compensation, farm valuations for book-keeping purposes ... 1215
Conferences and Congresses:
Agricultural education conference, report on agricultural education for women ... 859
Co-operation and Credit:
Allotments, co-operation in ... 961
Cattle insurance societies in 1913 ... 273
Co-operative credit associations in 1913 ... 273
Croydon vacant lands cultivation society ... 963
Development Commissioners' report for 1914–15 on grants ... 1175
Distributive societies in 1913 ... 270
Farm implement societies ... 413, 570, 784
Haddenham cattle insurance society ... 694
Hitchin bacon factory ... 317
Live stock breeding and improvement associations ... 46
Milk supply, organisation on co-operative lines ... 1307
Monographs on agricultural co-operation; Vol. II., issue by International Institute of Agriculture ... 370
Pig insurance societies in 1913 ... 273
Poultry keeping, co-operation in ... 327
Productive societies in 1913 ... 270
Selling by co-operative methods, suggestions from America ... 201, 370
War food societies ... 407, 894, 909
Women farmers' co-operative societies ... 637
Canada, agricultural credit in British Columbia ... 274
France, co-operative agricultural credit in 1913 ... 74
India, co-operative agricultural credit in the Punjab ... 368
Italy, Ferentino co-operative cattle insurance society ... 170
South Africa, land and agricultural bank ... 365
United States, the Wathena fruit growers' association ... 367
Copper salts, influence on wheat (*Woburn*) ... 404
Corn (see also *Crops*, *Wheat*, etc.):
Acreage and produce in 1914 ... 90, 506, 509
" " 1915 ... 701, 817, 1189
Grain, purchase by Government ... 1013
Growth of two white-straw crops in succession ... 533
Imports of grain in the cereal year ... 579
Manuring corn crops in spring of 1916 ... 1274
Offals, utilisation for feeding purposes ... 297, 1132
Prices, annual averages, 1909–15 ... 1037
Stubbles, use for feeding poultry ... 678
Cowgrass, report on quality of seed, 1912–14 ... 1046
Credit, see *Co-operation* and *Credit*.
Crops (see also specific crop, *Rotations*, *Agricultural Returns*, etc., "Agricultural Conditions in England and Wales," and "Notes on Crop Prospects Abroad" in each issue):
Bare fallows, need for reducing ... 1292
Catch crops and home-grown feeding stuffs ... 23, 266, 653
Continuous green cropping ... 31
Decline in the agricultural area of England and Wales ... 475
Growth of two white-straw crops in succession ... 533
Maintenance of production during the war ... 182
Systems of farming and the production of food ... 520
Valuation of crops for book-keeping purposes ... 1218
Ireland, area under crops, 1915 ... 467
Scotland, area under crops, 1915 ... 468
Crowther, C.: Dried yeast as a food for farm stock ... 1
Croydon vacant lands cultivation society ... 963
Cumberland and Westmorland travelling butter-making school ... 1008

Dairying:
Butter: Churning, methods of treatment of cream ... 359
Cumberland and Westmorland travelling butter-making school 1008
Mouldiness in butter (*U.S.*) ... 163

Dairying—*continued*— PAGE
Calf rearing 163, 361, 768
Cheese: Comparison of cheese-making with other methods of using milk 677
Rennet, preparation of home-made extract 241
Commercial Control Branch of the Board, reports for 1914 and 1915 374, 1259
Dairy Cattle: Conformation of cows and milk yield (Germany) ... 266
Feeding, see *Feeding Stuffs.*
Milk recording certificates of the Board, value 1292
Milk:
Bacteria, destruction by electricity 1229
Bacterial content, effect of condensing and drying the milk ... 267
Churning, methods of treatment of cream 359
Clotted cream 105
Colon bacilli, ability to survive pasteurisation (*U.S.*) ... 268
Comparison of milking twice or three times daily (*Durham C.C.*) 1305
Conformation of cows and milk yield (Germany) 266
Cost of food in milk production (*Yorkshire*) 1177
Cost of production in war time 981
" winter feeding in milk production 841
Factors of importance in milking 899
Feeding for winter milk (E. Sussex) 70
Freezing point of milk as a test for added water 267
Goat as a source of milk 642
Grass land of good quality for milk production 524
Manuring of grass land for milk (*Harper Adams*) 262
Milking machines 36, 73, 358
Milk recording societies, grants under the Board's scheme ... 49
Value of Board's certificate... 1292
Onion flavour, removal from milk (*U.S.*) 268
Organisation of the milk supply 1307
Sale of milk, circular letter as to hardship in conforming with Sale of Food and Drugs Acts 908
Time of milking, effect on quantity and quality (*Durham C. C.*)... 1305
Women, education and openings in dairy work 628
Denmark, progress of the dairy industry 124
Denmark: Investigations showing how tubercular fowls infect pigs ... 41
Progress of the live stock, dairy and poultry industries 122, 478
Development Fund: Live stock breeding and improvement, Board's scheme 46
Report of Development Commissioners for 1914–15 1172
Diseases of Animals and Veterinary Science (Diseases of Poultry, see *Poultry*):
Animals Division of the Board, report for 1914 87
Bacillary necrosis of the liver in unborn lambs (*Wye*) 165
Chief veterinary officer's report for 1914 ... ... 700, 704
Foot-and-mouth disease outbreaks 814, 910, 1021, 1179, 1308
Husk or hoose in calves 662
Parasitic mange amongst cast army horses, circular letter... ... 700
" " cacao shells (*Germany*) ... ...
Poisonous properties of castor oil seeds (*Germany*) 359
Rabies in an imported dog 177
Slaughter *of animals order of 1915* 370
Spread of disease from army horses to agricultural horses ... 1188
Swine fever, Board's scheme for treatment by serum injection 594, 691, 702
" final report of committee 690
" slaughter of pigs, reduction in 702
Tuberculosis, destruction of bacteria in milk by electricity ... 1229
" *prevalence among pigs in Great Britain* 704
" transmission from fowls to pigs 41
South Africa, inoculation of cattle in Rhodesia against the plasmoses.. 476
Diseases of Plants (see also *Insects* and *Fungi*):
Horticulture Branch of the Board, report for 1914–15 931
Smoke, effect on plant growth (*Leeds*) 168
France, establishment of plant diseases branch of Ministry of Agriculture 476
Distillers' grains, use for feeding purposes 300, 301, 1301
Down grazings, enclosing with wire fencing 721
Drug plants, collection and sale in England 62
" cultivation in Canada 913

PAGE

Dunne, J. J.: Danish investigations showing how tubercular fowls infect pigs ... 41
Progress of the live stock industry in Denmark ... 122

Earth-nut, see *Ground-nut*.
Edge, S. F.: Waste woodland for the breeding of pigs ... 977
Education:
Agricultural education conference, report on agricultural education for women ... 859
Cumberland and Westmorland travelling butter-making school ... 1008
Fream memorial prize ... 276
Development Commissioners' report for 1914–15 ... 1172
Grants for agricultural education and research, regulations for 1915–16 ... 65
" " " report for 1914–15 ... 708
Poultry management, short course at South Eastern Agricultural College ... 475
Sailors and soldiers, discharged, training of ... 813
Technical advice for farmers ... 37
Women, education and openings in horticulture and agriculture ... 554, 616
Eggs, see *Poultry*.
Electricity, destruction of milk bacteria by ... 1229
Ensilage: Maize ensilage ... 688
Preparation of silage ... 341
Silage as food for stock ... 1249
Special notice to farmers ... 372
Sugar beet crowns and leaves ... 757
Exhibitions and Shows: London thoroughbred stallion show, 1916 ... 907
Panama-Pacific international exhibition, 1915, live stock section ... 283
Experiments, see specific subject.
Export regulations, see *Import and Export Regulations*.
Exports, see *Imports and Exports*.
Eyre, J. Vargas: A new fungicide for use against American gooseberry-mildew ... 1118

Falkner, Lt.-Col. P. H.: Calico poultry-houses ... 969
Fallows, need for reducing ... 1292
Feeding and Feeding Stuffs (Poultry feeding, see *Poultry*):
Acorns ... 686, 902
Apple pomace ... 811, 855
Beans ... 305
Bran ... 299, 1132, 1301
Brewers' grains ... 300, 301, 1301
Buckwheat ... 1132
Bullocks, winter feeding (*Canada*) ... 1302
Cake feeding, manurial value (*Woburn*) ... 353
Calf feeding (*Harper Adams*) ... 163
" " (*Woburn*) ... 361
" rearing ... 768
Castor oil seeds, poisoning by (*Germany*) ... 359
Catch crops, suggestions for cultivation ... 23, 266, 653
Cattle, store, feeding in winter (*U.S.*) ... 71
Cereal offals ... 297
Coconut cake ... 304, 740
Commercial Control Branch of the Board, reports for 1914 and 1915 ... 374, 1259
Comparative values of feeding stuffs ... 52, 148, 248, 322, 456, 574, 680, 792, 887, 1001, 1149, 1276
Corn feeding, manurial value (*Woburn*) ... 353
Dairy cows, fattening of unprofitable animals (*Wye*) ... 164
" " feeding for winter milk (*E. Sussex*) ... 70
Distillers' grains ... 300, 301, 1301
Earth-nut, see *Ground-nut*.
Fertilisers and Feeding Stuffs Act, 1906, facilities for sampling and analysis ... 702
Fibre content, value in concentrated foods ... 899
Fish as cattle food (*India*) ... 70
Fish meal ... 305
Flax shives (*U.S.*) ... 268
Fodder, suggestions for increasing the amount ... 453
Forage crops, use for pig feeding ... 153

Feeding and Feeding Stuffs—*continued.* PAGE
Gluten meal and gluten feed 269, 302
Gorse 455
Grasses, various (*Germany*) 1304
Ground-nut cake 308, 740, 875
" meal for dairy cows (*France*) 269
Hempseed cake 1304
Home-grown feeding stuffs, suggestions for cultivation ... 23, 266, 653
Linseed feeding for calves 120
" growth for feeding purposes 29, 1069
Maize germ meal 303
" gluten feed for dairy cows (*France*) 269
Malt culms 239, 302
Manioc meal for dairy cows (*France*) 269
Middlings 300
Milk production, cost of winter feeding 841
" " feeding, etc., in war time 981
" " food (*Yorkshire*) 1177
Niger seed and cake 874
Palm-nut kernel cake 305, 738, 998
Phosphate, effect on yield and quality of milk 1305
Phosphorus requirements of lambs (*U.S.*) 1178
Pig feeding (*U.S.*) 70
" and rearing in waste woodland 977
" in Ireland, advice as to 351
" on forage crops 153
" on straw (*Germany*) 1303
" with uncooked meals (*Cockle Park*) 1303
Pomace from cider and perry making 811, 851
Potato tops 454
Railway transport 811, 1260
Reeds 454
Rice meal 303
Safflower seed and cake 875
Seaweed 1106
Sesame seed and cake 871
Sharps 300
Silage 341, 372, 688, 757, 1249
Soya bean, cake and meal 304, 1286
Starch equivalent theory 794
Stirks, winter feeding (*Cockle Park*) 1302
Straw, composition and digestibility (*Germany*) 900
Straw as fodder 453, 663, 1303
Sugar beet crowns and leaves 750
Unit prices of feeding stuffs 52, 148, 248, 322, 456, 574, 680, 792, 887, 1001, 1149, 1276
War, influence on supplies and use of feeding stuffs 737
Weeds, feeding value of certain species (*Germany*) 362
Wheat offals, composition 260
White mustard 25, 454, 1134
Yeast, dried 1, 302, 740
Guernsey, prevention of fraud in sale of feeding stuffs 915
Fencing, cost and methods of enclosing Downland with wire 721
Ferentino co-operative cattle insurance society 170
Fertilisers, see *Manures.*
"Feuillette" flax retting process (*France*) 169
Fish: Cattle feeding on fish (*India*) 70
Meal, utilisation as a feeding stuff 305
Mussels as manure 156
Flax (see also *Linseed*):
Development Commissioners' report for 1914-15 on grants ... 1174
Feeding value of flax shives (*U.S.*) 268
"Feuillette" process of retting (*France*) 169
Liming (*Ireland*) 355
Manuring (*Ireland*) 355
Varieties (*Ireland*) 354
Food supply during war time, see *War and Agriculture.*
[illegible] value of different kinds of produce 527
[illegible]s, Miss E. H.: Essay on the way in which women can assist agriculture, and the increased production of food during the war ... 929

PAGE

Forestry (see also *Insects* and *Fungi*):
Acorns, use as food for stock 686
,, bad effect on laying hens (*Germany*) 902
Advice in forestry 40
"Brown Oak," a disease of oak trees 902
Development Commissioners' report for 1914–15 on grants ... 1175
Home-grown timber committee 1019
Larch plantations in Ireland 231
Pig rearing in waste woodland 977
Rest period in plants (*U.S.*) 1179
Toxic effect of grasses and weeds around young trees 1178
Willow-growing and basket making 1081
Wood ash as a source of potash 146, 766
Woodpeckers and their relation to forestry 789
Dendrocopus major and *minor* 789
Gecinus viridis 789
Salix purpurea, *S. triandra* and *S. viminalis* 1081
Fowls, see *Poultry*.
Foxes, need and methods for destruction 815, 1165
Foxtail, report on quality of seed, 1912–14 1051
France: Co-operative agricultural credit in 1913 74
Plant diseases branch of Ministry of Agriculture, establishment ... 476
Fream memorial prize 276
Frost, protection of fruit against (*Canada*) 71
Fruit (see also *Crops*, *Insects*, *Fungi*, *Spraying*, *Breeding* and *Import Regulations*):
Apples: Cider acetification 939
,, blackening 167, 948
,, disorders and methods of combating 939
,, oiliness and ropiness 946
,, sickness 166, 944
,, sweetening (*Bristol*) 167
Pomace as a feeding stuff 811, 855
Spraying *v.* dusting against apple scab 270
Black currants, experiments in crossing 252
Farm orchards of Herefordshire 892
Frost, protection from (*Canada*) 71
Pears:
Experiments in crossing 252
Perry disorders and methods of combating 939
Pollination of fruit trees, observations and experiments 418
Pomace from cider and perry making, composition and uses ... 811, 851
Preserving for small market growers or for domestic use 447
Pulp, making of 450
Railway transport 782, 1261
Storage of apples and pears 697, 814
United States, the Wathena fruit growers' association 367
Fryer, J. C. F.: Capsid bugs 950
Notes on lime washes 1125
Fungi (see also *Diseases of Plants* and *Spraying*):
American gooseberry mildew, experiments in preventing 227, 364, 1118, 1244
,, ,, ,, Orders of 1915 ... ... 276, 279
,, ,, ,, warning 177
Apple scab (*U.S.*) 270
"Brown Oak," a disease of oak trees 902
Brown scab of potatoes (*Ireland*) 270
Celery leaf-spot 363
Hop mildew 1119
Horticulture Branch of the Board, report for 1914–15 931
Iris leaf-blotch disease 363
Potato blight (*Ireland*) 269, 270
,, disease 699
Stalk or sclerotium disease of potatoes (*Ireland*) 269
Wart disease of potatoes (*Scotland*) 364
,, ,, varieties suitable for infected areas ... 813
Heterosporium gracile... 363
Phytophthora infestans 699
Sphaerotheca mors-uvae 177, 227, 276, 279, 364, 1118, 1244
,, *humili* 1119

Fungi—*continued.* PAGE
Synchitrium endobioticum 364, 813
France, establishment of plant diseases branch of Ministry of Agriculture 476

Gardening, (see also *Small Holdings and Allotments*):
,, education and openings for women 554, 616
Garrad, G. H.: Cost of winter feeding in milk production 841
Genetics, see *Breeding*.
Germany: Agriculture and the war 741
Karakul sheep breeding centre near Leipzig 283
Germination of barley seed, conditions affecting 313
,, seeds, method of testing 364
Gilchrist, D. A.: Trials of wild white clover 1063
Gimingham, C. T.: The use of pressed apple pomace 851
The waste from saw-mills as a source of potash 146
Gluten meal and gluten feed, use for feeding purposes 269, 302
Goat as a source of milk 642
Golf links, grazing by sheep 177, 373
Goodall, A. A.: The breeding of utility pigeons 335
Gorse, use as fodder 456
Grain, see *Corn* and specific crops.
Grass, see *Pasture.*
Gray, R. A. H.: The prevention of egg-laying on turnips by the diamond-back moth 222
Green manuring 353, 356, 1134
Ground nut cake, use as a feeding stuff 308, 740, 876
,, meal as a food for dairy cows (*France*) 269
Grove, O.: Disorders of cider and perry 939
Guano, imports in 1914 377
Guernsey, sale of fertilisers and feeding stuffs act, 1915 915

Haddenham cattle insurance society 694
Halnan, E. T.: Influence of the war on supplies and use of feeding stuffs 737
Harper Adams College, egg-laying competitions of the Utility Poultry Club 594, 808, 1306
Harvest weather forecasts, supply by Meteorological Office in 1915 ... 178
Hay (see also *Pasture*):
Acreage and produce in 1914 90
,, ,, 1915 ... ... 701, 817, 1189
Influence of manure on crop and soil (*Garforth*) 1176
Manuring (*Chelmsford*) 162
,, (*Harper Adams*) 263, 264
,, (*Ireland*) 161
,, (*Rothamsted*) 358
,, of grass land 542
Natural and artificial drying of grass (*Germany*) 364
Production for the Army 183, 471
Rye-grass, varieties (*Woburn*) 357
Storage, effect on composition and digestibility (*Germany*) ... 363
Hempseed cake for dairy cows 1304
Hendrick, J.: The manurial situation and its difficulties 609
Composition and use of certain seaweeds 1095
Herefordshire, description of farm orchards 892
Hitchin bacon factory 317
Home production of food during war time, see *War and Agriculture.*
Hops:
Acreage and produce in 1914 90
,, ,, 1915 ... ... 595, 818, 1189
A new variety of hop—the "Foundling" 136
Manuring 260
Horses, see *Live Stock.*
Horticulture (see also *Fruit, Vegetables, Fungi, Insects* and *Spraying*):
Horticulture Branch of the Board, report for 1914–15 931
Women, education and openings in horticulture 554
Hudson, Miss E. L.: The Croydon vacant lands cultivation society ... 963
Hutchinson, H. P.: Willow-growing and basket-making as rural industries 1081

Imms, A. D.: Notes on beet or mangold fly 891
Implements, see *Machinery.*

Import and Export Regulations :
PAGE
Export of sulphate of ammonia 1076
Argentina, live stock 378, 906
Lucerne seed and seed of forage plants 915
Australia, cattle 1025
Bermuda, live stock and fodder 283
Canada, live stock 284
India, regulation of exportation of wheat 180, 372, 1013
Ireland, cattle 698
Jersey, forage 1025
New Zealand, live stock 906
Plants 1024
Russia, live stock 1295
Imports and Exports :
Exports, agricultural, in 1915 1160
Grain, imports in the cereal year, 1914-15 579
Imports of agricultural produce 514, 519, 986
Special Enquiries Branch, report on first twelve months of war ... 833
Wheat, average prices during 1913–1915, and countries from which received 1037
Australia, commission of enquiry into meat export trade, report ... 460
Canada, deputation to the Board as to importation of Canadian cattle 590
India, regulation of exportation of wheat 180, 372, 1013
Index number for comparing prices of agricultural produce in different years 911
India : Co-operative agricultural credit in the Punjab 368
Regulation of the exportation of wheat 180, 372, 1013
Inoculation (see also *Bacteriology*, *Diseases of Animals*, etc.) :
Peat, inoculation of crops with a preparation of (*Woburn*) ... 464
" " " " (*Midland*) ... 1297
Serum injection for treatment of swine fever 594, 691, 702
South Africa, inoculation of cattle in Rhodesia against the plasmoses 476
Insects (see also *Bees* and *Spraying*) :
Beet fly 881
Capsid bugs... 950
Diamond back moth... 222
Horticulture Branch of the Board, report for 1914-15 931
Larch-shoot moths 50
Mangold fly 881
Turnip gall weevil 884
Wireworms, attack on a barley crop 313
Argyresthia atmoriella, *A. laevigatella*, and *A. zellerella* 50
Atractotomus mali 950
Ceuthorynchus pleurostigma and *C. sulcicollis* 884
Lygus pratensis 950
Orthotylus marginalis 950
Pegomyia bicolor and *P. nigritarsis* 883
Pegomyia hyoscyami 881
Plesiocoris rugicollis 950
Plutella maculipennis... 224
Psallus ambiguus 950
Insurance : Co-operative insurance, see *Co-operation and Credit*.
National Insurance Act, 1911, regulations under 700
International Institute of Agriculture (for report on Crop Prospects see summary in each issue).
Bulletin of agricultural and commercial statistics 377
Financial statement for 1914 63
Monographs on agricultural co-operation ; Vol. II., issue of ... 370
Proceedings of the permanent committee 350
Relations with tropical and colonial agriculture 65
Third year-book of agricultural statistics 815
Ireland : Area under crops, 1915 467
Committee on home production of food, report 588
Larch plantations in the Galtee mountains 231
Number of live stock, 1915 466
Pig breeding industry 244
Seaweed cultivation for manure 462
Italian or Roman geese 791
Italy : Ferentino co-operative cattle insurance society 170

PAGE

Jaques, G.: Silage as food for stock 1249

Kainit, see *Manures*.
Kale, marrow-stem, growth 27
,, ,, time of sowing (*Chelmsford*) 266
,, thousand-headed, ,, ... 26
Karakul sheep 283, 434
Kew Gardens, charges for admission 1019
King's premium stallions, names and routes for 1915 74
Kohl rabi, time of sowing (*Chelmsford*) 266

Labour: *Agricultural workers and enlistment* 87, 809, 903, 905, 1013, 1015, 1181
Assistance by soldiers 371, 696, 1184
Labour exchanges and the war 178, 179
Land settlement for discharged soldiers and sailors 469, 813, 1166, 1188
Machinery and the labour supply 33
Military Service Act, 1916, notice to farmers 1181
National Insurance Act, 1911, regulations 700
Shortage owing to the war, measures taken 178, 179, 470, 907
Suggestions for saving labour 33, 653
Wages of agricultural labourers, increase in 374
Women, notices as to war work 472, 474
Women's work in agriculture in peace and war ... 554, 610, 859, 929, 1006, 1180, 1312
Larks, destruction 1164
Law, W.: Destruction of rats in E. Lothian 1238
Lead salts, influence on wheat (*Woburn*) 464
Leaflets of the Board in 1915 ... ... 373, 1020
,, ,, special 87, 468, 698, 1020
,, ,, issue of third bound volume 1021
Lees, A. H.: Summer sprays against American gooseberry mildew ... 1244
Lewis, F. C.: *A new method for the destruction of bacteria in large volumes of milk by means of electricity* 1229
Lights, carrying at night on farms... 1309
Lime: Application to soil rich in magnesia (*Woburn*) 353
Calcium carbide residue for liming 699, 1289
Leys, improvement by liming 1107
Lime-sulphur wash 1118
Lime washes, methods of use and value 1125
Pasture, improvement by liming 264
Sterilisation and neutralisation of soils with lime ... 255, 353
Use for liberating potash contained in the soil 404
Linseed (see also *Flax*):
Calf feeding on linseed 120
Growth as a farm crop 29, 1069
Oil content, effect of certain factors 255
Varieties 1073
,, (*Harper Adams*) 256
,, (*Woburn*) 356
Live Stock (see also *Co-operation and Credit, Diseases of Animals, Breeding, Feeding Stuffs, Meat, Import Regulations* and Monthly Notes):
Animals Division of the Board, report for 1914 87
Bulletin of agricultural and commercial statistics issued by the International Institute of Agriculture 377
Cattle: Bulls, grants for breeding and improvement 47
Calf rearing 768
Calves, fluctuations in weight after birth (*Germany*) 266
Manuring of grass land for meat (*Harper Adams*) 262
Dairy Cows, see *Dairying*.
Feeding of Stock see *Feeding Stuffs*.
Goat as a source of milk 642
Kids, fluctuations in weight after birth (*Germany*) 267
Grazing in common 1291
Horses: Committee on supply of horses for military purposes 590, 1022, 1253
Feeding see *Feeding Stuffs*.
Heavy [illegible] ... 1253

Live Stock—*continued*. PAGE
Mares for breeding, sale after use by the Army 277
Stallions, London thoroughbred show, 1916 906
Walker, Colonel Hall, purchase of stud by the Government ... 911
Improvement of live stock, breeding associations 46
,, ,, Development Commissioners' report for 1914–15 on grants 1174
Improvement of live stock, report on administration of grant, 1914-15 706
Index number for comparing prices of live stock in different years ... 911
Insurance, see *Co-operation* and *Credit*.
Live stock officers 40
Maintenance of live stock: notice as to, and Act and Order of 1915 182, 275, 468, 591, 1018
Number of live stock in England and Wales, 1915 597
,, ,, the United Kingdom, 1914 ... ... 90, 509
,, ,, ,, ,, 1915 ... ...701, 1189
Pigs: Boars, grants for breeding and improvement 48
Clubs, see *Co-operation* and *Credit*.
Feeding, see *Feeding Stuffs*.
Fluctuations in weight of newly-born pigs (*Germany*) ... 266
Hitchin bacon factory 317
Irish pig breeding industry 244
Pigmentation of bacon (*Cambridge*) 1304
Waste woodland for rearing pigs 977
Sheep: Fat lambs from Welsh crosses (*Harper Adams*) 163
Feeding, see *Feeding Stuffs*.
Grazing on golf links 177, 373
Hereditary twinship (*U.S.*) 1178
Karakul sheep 283, 434
Lambs, fluctuations in weight after birth (*Germany*) 266
Manuring for mutton (*E. Suffolk C. C.*) 161
Slaughter of animals, notice as to, and Order of 1915 182, 370, 468, 469, 702
Valuation of stock for book-keeping purposes 1219
Brazil, methods of live stock improvement 1294
Canada, deputation to the Board as to importation of Canadian cattle 590
Denmark, progress of the live stock industry 122, 478
Germany, Karakul sheep breeding centre near Leipzig 283
Ireland, pig breeding industry 244
Number of live stock, 1915 466
Scotland, number of live stock, 1915 467
United States, Panama-Pacific International Exhibition, 1915, live stock section 283
London thoroughbred stallion show, 1916 907
Lucerne:
Varieties (*Chelmsford*) 265
,, (*Woburn*) 356

Machinery: Co-operative farm implement societies 413, 570, 784
Disc harrows 784
Labour supply and machinery... 33
Milking machines 36, 73, 358
Motor ploughs and tractors 34, 413, 570, 760, 784
Rail transport delay 177, 781, 1260
Valuation for book-keeping purposes 1224
Magnesia, effect on wheat and mangolds (*Woburn*) 464
,, relation to lime in soils 353
Maintenance of Live Stock Act, 1915 468
,, ,, Order, 1915 ... ... 275, 591, 1018
Maize: Germ meal, for feeding purposes 303
Gluten feed for dairy cows 269, 302
Growth 28
,, (*Chelmsford*) 265
Methods of using green maize 688
Malden, W. J.: Notes on machinery and the labour supply 33
Malt culms, use as a feeding stuff 239, 302
Manganese as manure 806, 1297
Mangolds: Acreage and produce in 1914 ... ... 90, [illegible], 1189

Mangolds—*continued.* PAGE
Germination (*Harper Adams*) ... 357
Magnesia, effect on growth (*Woburn*) ... 464
Manuring (*Chelmsford*) ... 256
,, (*Hereford Educ. Com.*) ... 257
,, (*Midland*) ... 1301
,, (*Rothamsted*) ... 357
Salt in place of potash ... 402
Seed, report on quality, 1912–1914 ... 1049
Top-dressing (*Harper Adams*) ... 357
Varieties (*Chelmsford*) ... 256
,, (*Harper Adams*) ... 358
,, (*Midland*)... ... 1301
Manioc meal as food for dairy cows (*France*) ... 269
Manures (see also specific crops):
Ashes for production of potash ... 146, 766
Basic slag, time at which to apply to grass land ... 1013
,, valuation of phosphate content ... 897
Cake and corn, comparison of manurial values (*Woburn*) ... 353
Calcium carbide residue for liming ... 699, 1289
Commercial Control Branch of the Board, reports for 1914 and 1915 374, 1259
Compound manures, suggestions for mixing ... 675
Copper salts, effect on wheat (*Woburn*)... ... 464
Corn and cake, comparison of manurial values (*Woburn*) ... 353
Farmyard manure, bracken, use for making dung ... 689, 699
,, ,, composition, storage and application ... 131, 168, 1270
,, ,, effect of straw on the utilisation of nitrogen (*Austria*) 157
Fertilisers and Feeding Stuffs Act, 1906, facilities for sampling and analysis ... 702
,, committee to control supplies ... 811, 1015, 1180
,, monthly notes on prices and values ... 1156, 1281
,, need for increased use in Wales ... 1263
Green manuring ... 353, 355, 1134
Guano, imports in 1914 ... 377
Humus, soluble, effect on productiveness of soil ... 1298
Lead salts, influence on wheat (*Woburn*) ... 464
Lime, application to soil rich in magnesia (*Woburn*) ... 353
,, for sterilisation and neutralisation of soils ... 255, 353
,, substituted for potash for leguminous crops ... 404
Liquid manure ... 346, 1273
Magnesia, effect on wheat and mangolds (*Woburn*) ... 464
Manganese (*Germany*) ... 806
,, sulphate (*Midland*) ... 1297
Manurial situation and its difficulties ... 609
Mussels ... 156
Niger cake ... 874
Nitrate of lime ... 1296
Nitrate of soda, imports in 1914 ... 377
,, shipment from Chile ... 1018
Nitrogenous manures, supply in war time ... 612
,, ,, tests with various kinds (*Germany*) ... 159
Nitrolim, granular ... 1287, 1296
Peat, bacterised (*Midland*) ... 1297
,, ,, (*Woburn*) ... 464
,, moss litter manure (*Germany*) ... 158
Phosphate, value of soluble and insoluble in basic slag ... 897
Phosphates, mineral, imports in 1914 ... 377
Phosphatic manures, supply in war time ... 613
,, manuring as a means of accumulating fertility in grass land ... 1201
Phosphoric acid, citric soluble, production and value (*U.S.*) ... 68
Pomace from cider and perry making ... 851
Potash, from ashes ... 146, 766
,, production and value (*U.S.*) ... 68
,, shortage caused by the war ... 393, 614
,, substitutes ... 68, 400, 402, 404
,, supply of the world ... 672
Radio-active manure (*Germany*) ... 806
,, ,, (*U.S.*) ... 68, 354, 806
Railway transport ... 1280

Manures—*continued.*
PAGE
Salt as a substitute for potash 68, 402
Saw-mill waste as a source of potash 146
Seaweed 462, 1095
Sesame cake 873
Sewage sludge 235
Sugar beet crowns and leaves 750
Sulphate of ammonia (*France*) 1297
,, ,, need for increased purchase by farmers 1180, 1267, 1309
,, ,, Parliamentary Secretary's letter to "Times" as to exportations 1016
,, ,, *production and quality in 1914* 376
Sulphur (*Germany*) 354
Superphosphate, purchase of 1270
Supplies of fertilisers, appointment of committee 811
Weeds, manurial value of certain species (*Germany*) 362
Guernsey, prevention of fraud in sale of fertilisers 915
Market gardening, see *Small Holdings and Allotments*.
Markets: Co-operative selling and the use of trade marks 201, 370
Railway transport of agricultural produce ... 177, 781, 811, 1260
Special Enquiries Branch, report on first twelve months of war ... 833
United States, the Wathena Fruit Growers' Association 367
Meadows, see *Pasture* and *Hay*.
Meat: Beef, manuring for (*Harper Adams*) 262
Black discoloration of bacon (*Cambridge*) 1304
Hitchin bacon factory 317
Maintenance of live stock, notice as to, and Act and Order of 1915 ... 182, 275, 468, 591, 1018
Mutton, manuring for (*E. Suffolk C.C.*) 161
Production on grass and arable land 521, 525
Slaughter of Animals Order of 1915 ... ... 182, 370, 408, 469, 702
Supplies during war, measures taken by Special Enquiries Branch ... 839
Australia, commission of enquiry into meat export trade, report ... 460
Ireland, pig breeding industry 244
Medicinal plants, collection and sale in England 62
,, cultivation in Canada 913
Mendelism, see *Breeding*.
Meteorological Office, supply of harvest weather forecasts in 1915 ... 178
Mice, destruction 1163
Middlebrooke, W. J.: Pollination of fruit trees: observations and experiments from 1904 to 1912 418
Middleton, T. H.: Paper read to agricultural section of British Association 520
Middlings, utilisation for feeding purposes 300
Milk, see *Dairying*.
Millet, growth (*Chelmsford*) 265
Morden Hall, chicken rearing demonstration, 1913–14 10
,, egg-laying demonstration, 1914–15 331
Motor ploughs, tractors, and disc harrows 34, 413, 570, 760, 784, 787
Mussels as manure 156
Mustard, brown, growth 26, 1134
,, white ,, ... 25, 454, 1134
Mutton, see *Meat*.

National Insurance Act, 1911, regulations 700
Niger seed and cake 874
Northbrook, Lord, speech at food supply meeting 502
Northern Utility Poultry Society egg-laying competition 658

Oats (see also *Corn* and *Crops*): 90
Acreage and produce in 1914 ... ... 701, 817, 1189
,, ,, 1915 165
Identification of the country of origin (*Cirencester*) 356
Manuring (*Rothamsted*) 1275
,, in spring of 1916 ... ...581, 1037
Prices of British oats, averages 262
Rate of seeding (*Harper Adams*) 70

	PAGE
Oats (see also *Corn* and *Crops*)—*continued*—	
Varieties, (*Glasgow*)...	1300
,, (*Harper Adams*)	262
,, (*Midland*)	1300
,, (*Woburn*)	356
Winter oats, varieties and growth	582
,, varieties (*Leeds*)	808
Onion flavour, removal from milk (*U.S.*)	268
Orchards, see *Fruit*.	
Orwin, C. S. and Orr, J.: The cultivation of sugar beet in the West of England	210
Packing of produce for sale, suggested methods	201, 781
Palm-nut kernel cake, use as a feeding stuff	305, 738, 998
Panama-Pacific International Exhibition, 1915, live stock section ...	283
Pasteurisation, see *Bacteriology*.	
Pasture (see also *Hay* and *Crops*; also *Clover, Lucerne, Rye-grass* and other specific plants):	
Basic slag	1013
Breaking up grass land	550
Clover and grass mixtures (*Woburn*)	356
Common, grazing in	1201
Farm seeds, report on quality, 1912–14	1041
Feeding value of various species of grasses (*Germany*)	1304
Improvement of leys	1107
Liming (*Harper Adams*)	264
Maiden seeds	453
Manures, action on different types of grass land	161
Manuring (*Harper Adams*)	263
,, (*Northants C. C.*)	161
,, of grass land	542, 1262
,, of meadow land, influence on crop and soil (*Garforth*) ...	1176
,, of poor meadow land (*E. Suffolk C. C.*)	162
,, for meat and milk (*Harper Adams*)	262
,, for mutton (*E. Suffolk C. C.*)	161
Meat production on grass land	521
Milk production on grass of good quality	524
Phosphatic manuring, accumulated fertility in consequence of ...	1201
Seed testing, facilities in England and Wales	1055
Toxic effect of grass round young trees	1178
Upland grazings, methods of improvement	1176
Wire fencing, and the enclosing of Downs	721
Paynter, F. G.: Chicken rearing at Morden Hall, 1913–14	10
Egg production at Morden Hall, 1914–15	331
Pears, see *Fruit*.	
Peas: Acreage and produce in 1914	90
,, ,, 1915	...817, 1189
Growth	29
Manuring	1271
Varieties (*Chelmsford*)	266
Peat, analysis and ability to grow certain crops (*Ireland*)	897
,, bacterised, as manure (*Midland*)	1297
,, moss litter manure (*Germany*)	158
,, inoculation of crops with a preparation of (*Woburn*)	464
Pegler, H. S. H.: The goat as a source of milk	642
Perry, see *Fruit—Pears*.	
Petherbridge, F. R.: Experiments on American gooseberry mildew in Cambridgeshire	227
Petre, Colonel: Experiments in crossing black currants and pears ...	252
Phosphate, see *Feeding and Feeding Stuffs* and *Manures*.	
Pigeon breeding for utility purposes	335
Destruction of wood pigeons	1164
Pigs, see *Live Stock*.	
Plant Diseases, see *Diseases of Plants*.	
Ploughing up grass land to increase the food supply	550
,, with motor ploughs and motor tractors ...	34, 413, 570, 760, 784
Plums, see *Fruit*.	
Poisoning of stock by castor oil seeds (*Germany*)	359

Pollination, see *Fruit* and *Hops*. PAGE
Potash, see *Manures*.
Potatoes (see also *Fungi, Spraying, Insects, Import Regulations* and *Crops*):
Acreage and produce in 1914 90
,, ,, 1915 ... ... 701, 910, 1189
Cultivation, various methods (*Ireland*) 260
Manuring 1271
,, (*Lindsey C. C.*) 259
,, (*Northants C. C.*) 259
,, (*Rothamsted*) 358
Old potatoes, consumption in preference to new 371
Seed, growing by means of mulching (*U.S.*) 1136
,, ripe *v.* unripe (*Midland* and *Australia*) 1299, 1300
,, sprouted *v.* unsprouted (*Dorset C. C.*) 1299
,, trials of change of source (*Chelmsford*) 259
Tops, use as fodder. 454
Varieties (*Chelmsford*) 160
,, (*Dorset C. C.*) 1299
,, (*Edinburgh*) 1298
,, (*Lindsey C. C.*) 160
,, (*Midland*) 1299
,, (*Northants C. C.*) 160
,, suitable for planting in areas infected by wart disease ... 813
Poultry: Acorns, bad effect on laying hens (*Germany*) 992
Breeding stock, selection of suitable birds 877
Calico poultry-houses 969, 1140
Chicken rearing at Morden Hall, 1913–14 10
Chickens, hints on hatching 879
,, increase in numbers and quality 1293
,, precautions for safety when received by post or rail ... 1147
,, rearing and feeding 1139
Co-operative methods in poultry keeping 326
Development Commissioners' report for 1914–15 on grants ... 1174
Eggs: Bacterial content (*U.S.*) 167
Collection for wounded soldiers 176, 699
Description as fresh and new laid 590
Laying competition at Burnley 658
,, competitions of the Harper Adams College and the Utility Poultry Club 594, 808, 1306
Precautions for safety when received by post or rail for hatching 1148
Production at Morden Hall, 1914–15 331
Sittings of eggs of pure breeds, Board's scheme for distributing 812
Supply, suggestions for increasing 461
Variations in physical characteristics (*U.S.*) 901
Foxes, need for destruction 815, 1165
Italian geese 791
Local restrictions under Public Health Act, 1875 1021
Quills of geese, turkeys and ducks, supply during the war... ... 690
Report on the poultry industry in Wales, *Journal* supplement ... 694
Roman geese 791
Short course in poultry management at South Eastern Agricultural College 475
Stubbles, use for feeding poultry 678
Tubercular fowls, how they infect pigs 41
Tumours in fowls (*U.S.*) 1306
Women, education and openings in poultry work 633
Belgium, poultry keeping at Lippeloo 329
Denmark, progress of the poultry industry 129
Prices (see also *Agricultural Statistics*):
Agricultural produce, prices and supplies in 1914 ... ... 511, 906
Corn prices, annual averages, 1909–1915 1037
Feeding stuffs, prices and unit values 52, 148, 248, 322, 456, 574, 680, 792, 887, 1001, 1149, 1276
Imports, prices 996
Index number of prices of agricultural produce 911
Special Enquiries Branch, report on first twelve months of war ... 833
Pulse, see *Beans* and *Peas*.
Punjab, see *India*.

Quills, supply during the war 690

PAGE
Rabbit breeding on small holdings 140
Rabbits, destruction 1165
Radio-active substances as fertilisers (*U. S.* and *Germany*) ... 68, 354, 806
Railway transport of agricultural produce 177, 781, 811, 1206
Rape, growth 26, 27
Rats, destruction 87, 1162, 1238
Reclamation and improvement of land: Allotments 958
Bog land, use for growing certain crops (*Ireland*) 897
Croydon Vacant Lands Cultivation Society 963
Development Commissioners' report for 1914–15 on grants ... 1175
War food societies 407, 894, 909
Wire fencing on down grazings 721
Recruiting of agricultural workers, see *War and Agriculture.*
Reeds, use as fodder 454
Rennet, preparation of home-made extract 241
Research: Development Commissioners' report for 1914–15 ... 1172
Grants for agricultural education and research, regulations for 1915–16 65
" " " report for 1914–15 ... 708
Institutes for research in various subjects 39
Rew, R. H.: Presidential address to agricultural section of British Association, 1915 504
Rhodesia, see *South Africa.*
Rice flour, use for making bread (*France*) 465
" meal, use for feeding purposes 303
Robertson, G. S.: New feeding stuffs 871
Robinson, G. W.: Soils and agriculture of North Wales 216
Roman or Italian geese 791
Rooks, destruction 1293
Root crops, see specific crops.
Rotation of crops: Bare fallows, need for reducing 1292
Continuous green cropping 31, 266
Manuring and rotation of crops (*E. Suffolk C. C.*) 264
Suggestions for improving Welsh rotations 1107
Rothamsted Experimental Station: Monthly notes on fertilisers 1156, 1281
Russell, E. J.: How can crops be grown without potash manures? ... 393
On growing two white-straw crops in succession 533
Soil analysis 116
Rye: Acreage and produce in 1914... 90
" " 1915... 1189
Growth of 24, 27
Rye-grass, excessive use in "seeds" mixture 1112
" growth of Italian 25
" report on quality of Italian and perennial rye-grass, 1912—1914 1050
" varieties (*Woburn*) 357

Sadler, W.: Clotted cream 105
Safflower seed and cake 875
Sainfoin, report on quality of seed, 1912—1914 1049
Sale of Food and Drugs Acts, circular letter as to hardships in sale of milk 908
Salmon, E. S.: A new variety of hop—the "Foundling" 136
A new fungicide for use against American gooseberry-mildew ... 1118
Salt as a substitute for potash 68, 400
San Francisco, Panama-Pacific international exhibition, 1915 283
Sankey, G. C.: The use of stubbles for poultry 678
Saw-mill waste as a source of potash 146
Scotland: Area under crops, 1915... 468
Committee on home production of food... 586
Number of live stock, 1915 467
Seed testing station at Edinburgh 281
Seaweed, composition and manurial and feeding values 1095
" cultivation in Ireland for manure 462
Seeds (see also *Weeds* and *Import Regulations*):
Barley seed, conditions affecting germination 313
Clustered clover seed as an adulterant of white clover seed ... 253
Farm seeds, report on quality, 1912—1914 1041
Germination, method of testing 364
Railway transport 1260
Scottish seed-testing station 281
Testing of seeds, facilities in England and Wales... ... 1055, 1290

Seeds (see also *Weeds* and *Import Regulations*)—*continued*— PAGE
White clover seed, adulteration 253, 997
France, establishment of a plant diseases branch of Ministry of Agriculture 476
Selborne, Lord: Speech at food supply meeting 489
Selling by co-operative methods, suggestions from America 201, 370
Serum injection for treatment of swine fever 594, 691, 702
Sesame seed and cake 871
Sewage sludge as manure 235
Sharps, use for feeding purposes 300
Sheep, see *Live Stock*.
Shows, see *Exhibitions*.
Silage, see *Ensilage*.
Slaughter of animals order of 1915 ... ... 182, 370, 468, 469, 702
Small holdings and allotments (see also *Poultry*, *Co-operation* and specific crop):
Allotments, methods for improvement 958
,, report on, 1914 281
Co-operative farm implement societies 413, 570, 784
Croydon vacant lands cultivation society 963
Fruit preserving for small market growers or for domestic use ... 447
Fruit pulp, making of 450
Increase of food production, President's circular letter 1011
Land settlement for discharged sailors and soldiers 469, 813, 1166, 1188
Manuring of cottage gardens and allotments 1270
Pigeon breeding 335
Progress of small holdings movement 73
Rabbit breeding on small holdings 140
War food societies 407, 894, 909
Women, education and openings in horticulture and agriculture ...554, 616
Smoke, effect on plant growth (*Leeds*) 168
Sodium compounds, use for liberating potash contained in the soil 68, 400, 402
Soils: Acidity, testing with litmus paper (*Canada*) 1298
Analysis of soils, values and difficulties 116
Atmosphere of the soil 352
Humus, soluble, effect on productiveness of soil 1298
Lime, application to soil rich in magnesia (*Woburn*) 353
,, for sterilising and neutralising soils 255, 353
North Wales, soils and agriculture 216
Peat, inoculation of crops with a preparation of (*Midland*) ... 1297
,, ,, ,, (*Woburn*) ... 464
Potash in the soil, methods of rendering available 400
Sterilisation by steaming (*U.S.*) 807
,, partial, by antiseptics 158
Somerville, W.: Accumulated fertility in grass land in consequence of phosphatic manuring: second report on experiments ... 1201
Wire fencing 721
Sorghum, growth and utilisation 28, 155, 265
South Africa: Inoculation of cattle in Rhodesia against the plamoses ... 476
Land and agricultural bank 365
South Eastern Agricultural College, short course in poultry management 475
Soya bean, growth and use for feeding purposes 304, 1286
Sparrows, destruction 1164
Special Enquiries Branch, report for first 12 months of war 833
Spinks, G. T.: Experiments on American gooseberry-mildew in Cambridgeshire 227
Spraying: American gooseberry-mildew, spraying against 227, 364, 1118, 1244
Ammonium sulphide solution, use against American gooseberry-mildew 1118
Apple scab, spraying *v.* dusting against (*U.S.*) 270
Bordeaux mixture 71, 72, 269, 270
Burgundy mixture 269, 270
Dusting *v.* spraying (*Ireland*) 270
,, ,, (*U.S.*) 270
Hop mildew, spraying against 1119
Lime-sulphur wash 1118
Lime washes, methods of use and value 1125
Liver-of-sulphur solution 1120, 1244

Spraying—*continued*— PAGE
Potato blight, spraying against (*Ireland*) 269, 270
Potato spraying with Bordeaux paste and Bordeaux mixture (*Woburn*) 72
Winter spraying of fruit trees 901
Stapledon, R. G.: Some methods of adding to our food supplies ... 1107
Statistics, see *Agricultural Returns and Statistics.*
Sterilisation, see *Soils, Seeds, Bacteriology, Pasteurisation*, and *Dairying*.
Straw: Composition and digestibility (*Germany*) 900
Growth of two white straw crops in succession 533
Effect on the utilisation of nitrogen in farmyard manure 157
Use as fodder 453, 663, 1303
Strawberries, see *Fruit.*
Sugar beet (see also *Crops*):
Cultivation in the West of England 210
Feeding and manurial value of crowns and leaves 750
Growth 1210
Sulphate of ammonia, see *Manures.*
Sulphur as manure 354
Supplement to the *Journal*: Report on the poultry industry in Wales 694
Swedes:
Acreage and produce in 1914 90
" " 1915 ... ... 701, 910, 1189
Manuring (*Aberystwyth*) 259
" (*Hereford Educ. Com.*) 257
" (*Northants C. C.*) 258
Time of sowing (*Chelmsford*) 266
Swine, see *Live Stock.*

Threshing with the aid of a motor tractor 573
Timber, see *Forestry.*
Timothy grass, report on quality of seed, 1912–14 1052
Tithe, etc., Acts, report of proceedings under, 1914 281
" maps, alteration in facilities for examination 1019
Tobacco:
Development Commissioners' report for 1914–15 on grants ... 1174
Growth (*Ireland*) 264
Tractors, motor, for ploughing and other work ... 34, 413, 570, 760, 784
Transport by rail of agricultural produce 177, 781, 811, 1260
Trefoil, report on quality of seed, 1912–14 1049
Tropical agriculture and the International Institute of Agriculture ... 65
Tuberculosis, see *Diseases of Animals.*
Turnips:
Acreage and produce in 1914 90
" " 1915 ... ... 701, 910, 1189
Hardy green turnips, growth 27
Manuring (*Ireland*) 258
Twine, binder, transport by rail 177

United States:
Co-operative methods of marketing produce 201, 370
Fruit growers' association at Wathena 367
Panama-Pacific international exhibition, 1915, live stock section ... 283
Utility Poultry Club's egg-laying competitions at Harper Adams College 594, 808, 1306

Valuation of farm stock for book-keeping purposes 1215
Vegetables, see specific crops.
Vermin, destruction on farms 87, 815, 1162, 1238
Vetches, growth 30
Veterinary science, etc., see *Diseases of Animals.*
Vickers, V. R. S.: Successful employment of women on a farm ... 1006
Village war food societies 407, 894, 909

Waddingham, J. H.: Some Irish larch plantations 231
Wages, see *Labour.*
Wales, North, soils and agriculture 216
" Suggestions for increasing the production of food in 1262
Walker, Colonel Hall, purchase of stud by the Government 911
Wallace, R.: Karakul sheep 434

War and agriculture (see also specific subject): PAGE
Agricultural consultative committee 178
,, workers and enlistment ... 87, 809, 903, 905, 1013, 1015, 1181
Allotments, President's circular letter as to *increase of food production* 1011
Animals, production and slaughter 182
Breaking up grass land 550
Chickens, increase in numbers and quality 1293
Crop returns, avoidance of delay 275
Crops, maximum production 182
Egg collection for wounded soldiers 176, 699
,, *supply, suggestions for increasing* 461
Ensilage, special notice to farmers 372
Feeding stuffs, influence of the war on supplies and use 737
Food supply: *Bare fallows, reduction in* 1292
Croydon Vacant Lands Cultivation Society 963
Economy in food 583
Home production, assistance by children 905
,, circular letters as to need for increase 816, 1183
,, committees on 370, 494, 585, 803
Improvement of allotments 958
Suggestions for increasing 1107, 1262
Supplies and production, addresses at British Association, 1915 504, 520
Supply meeting, Lord Selborne's and other speeches 489
Slaughter of pigs to prevent spread of swine fever reduced ... 702
War food societies 407, 894, 909
Germany, action taken to conserve food supply 741
Hay for the Army 183, 471
Hay-making, employment of soldiers 371
Horses, committee on supply for military purposes ... 590, 1022, 1253
Labour, assistance by soldiers 696, 1148
,, shortage owing to the war. and measures taken .. 178, 179, 470, 907
,, suggestions for saving 33, 653
Land settlement for discharged soldiers and sailors 469, 813, 1166, 1188
Lights, *carrying at night on farms* 1309
Live stock returns, avoidance of delay 275
Maintenance of Live Stock Act, 1915 468
,, Order, 1915 1018
Mares for breeding, sale after use by the army 276
Meat supply, maintenance 275
Military Service Act, 1916, notice to farmers 1181
Milk production 981
Parasitic mange amongst cast Army horses, circular letter ... 700
Potash, methods of remedying shortage caused by the war 146, 393, 614, 766
Potatoes, consumption of old tubers in preference to new ... 371
Selborne, Lord, appeal to farmers in England and Wales 670
Sheep grazing on golf links 177, 373
Slaughter of Animals... ... ... 370, 468, 469, 702
Special Enquiries Branch, report on first twelve months of war ... 833
Spread of disease from Army horses to agricultural horses ... 1188
Sulphate of ammonia, need for increased purchase by farmers 1180, 1267, 1309
Transport by rail, notice as to delays 177, 811
Wages of agricultural labourers, increase in 374
War agricultural committees 702, 861, 907, 1013, 1015, 1185
,, food societies 407, 894, 909
Wheat, regulation of export from India to Great Britain 180, 372
Women, notices as to war work 472, 474
,, *work in agriculture in peace and war*
554, 616, 859, 929, 1006, 1180, 1312

Waste land, reclamation and improvement, see *Reclamation and Improvement of Land.*
Bracken, use as litter **689, 699**
Farm seeds, report on quality, 1912–1914 ... ... **1041**
Feeding value of certain species (*Germany*) **362**
Identification of the country of origin of oats by means of the weed species contained (*Cirencester*) **165**
Manurial value of certain species (*Germany*) **362**
Medicinal plants, collection and sale in England **62**
Need for destruction **1061**
Scottish seed testing station **281**

PAGE

Weeds (*see also Seeds*):
  Seed-testing facilities in England and Wales ... 1055, 1290
  Toxic effect of weeds round young trees ... 1178
  Canada, weed control acts and methods ... 184
    Cultivation of medicinal plants ... 913
Welsh, J. W.: The Hitchin bacon factory ... 317
Western wolths grass, growth ... 25
Westmorland and Cumberland travelling butter-making school ... 1008
Wheat (see also *Corn* and *Crops*):
  Acreage and produce in 1914 ... 90
  „ „ 1915 ... 701, 817, 1189
  Autumn wheat, manuring in spring of 1916 ... 1274
  "Benefactor" variety of wheat ... 807, 1009
  Composition of wheat and its by-products (*Ireland*) ... 260
  Continuous growth (*Rothamsted*) ... 535
  Copper salts, influence on growth (*Woburn*) ... 464
  Green manuring (*Woburn*) ... 353
  Growth of two white-straw crops in succession ... 533
  Imports ... 579
  Lead salts, influence on growth (*Woburn*) ... 464
  Manuring ... 540, 1274
  Magnesia, influence on growth (*Woburn*) ... 464
  Offals, utilisation for feeding purposes ... 297
  Price during war, suggestions for a minimum ... 494, 585, 893
  Prices of British wheat, averages ... 581, 1037
  „ imported wheat, averages, 1913–1915 ... 1037
  Rate of seeding (*Harper Adams*) ... 261
  Spring sowing, selection of suitable varieties ... 867
  „ wheat manuring in spring of 1916 ... 1274
  „ „ varieties (*Leeds*) ... 898
  „ „ „ (*Midland*) ... 1300
  Stubbles, use for feeding poultry ... 678
  Threshing with the aid of a motor tractor ... 573
  Top-dressing in autumn ... 777, 810
  Varieties (*E. Suffolk*)... ... 69, 808
  „ (*Harper Adams*) ... 261
  „ (*Ireland*) ... 69
  „ (*Leeds*) ... 807, 1009
  „ (*Northants*) ... 69
  „ (*Salop C. C.*) ... 1010
  „ (*Woburn*) ... 898
  „ from Egypt, suitability for export to England ... 261
  Winter wheat varieties (*Chelmsford*) ... 69
  India, regulation of the exportation of wheat to Great Britain 180, 372, 1013
Wibberley, T.: Co-operative farm implement societies ... 413, 570, 784
Wilkins, Mrs. R.: The work of educated women in horticulture and agriculture ... 554, 616
Willow-growing and basket-making ... 1081
Wilson, P. E.: Rabbit breeding on small holdings ... 140
Wire fencing ... 721
Women, education and openings in horticulture and agriculture ... 554, 616
  „ notices as to war work ... 472, 474
  „ work in agriculture in peace and war ... 859, 929, 1006, 1180, 1309
Woods, see *Forestry*.
Woodpeckers and their relation to forestry ... 789
Wood pigeons, destruction ... 1164
Wyllie, J.: *Farm valuations for book-keeping purposes* ... 1215

Yeast, dried, as food for farm stock ... 1, 302, 740